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GYPSOPHILY AMONG MEXICAN DESERT PLANTS

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WHILE collecting in northern Mexico I became interested in plants growing on gypsum, and particularly those which appear to be restricted to gypseous soils. Since a goodly number of species appear to prefer gypsum, and some of them even seem to be obligate gypsophiles, I have been surprised to find American botanists have given no particular attention to gypsum as a special plant-habitat. Gypsophilous plants have been ignored by ecologists and plant-geographers, who have failed to recognize them as a small, but very interesting and noteworthy element in the xerophytic floras of northern Mexico and adjacent United States. The present paper is published with the hope of directing attention to this interesting but neglected subject. It is a preliminary report and is concerned only with my observations on the gypsophilous plants of the desert plateau of northern Mexico.

Exposures of gypsum are scattered widely over the intermontane plateau of northern Mexico and northward through New Mexico and western Texas to Colorado and western Kansas. These exposures of hydrous calcium sulphate vary in size from large areas, sometimes covering many square miles, down to small inconspicuous local outcroppings. They may form cliffs, chalky gypsum flats, or, as at the White Sands, N. M., rarely even dunes of gypsum-sand. The erosion of gypsum beds has produced soils containing all possible gypsum mixtures. Though widely distributed, gypsum and gypseous soils are scattered irregularly and frequently they are separated by considerable distances.

If we may judge from their published reports or from the habitat-data found on their herbarium labels, botanists collecting in northern

Mexico have generally failed to recognize gypsum. Plants collected on beds of nearly pure gypsum have had the substratum, if mentioned at all, commonly described as "limy," "calcareous," "chalky" or even "saline." Many references to "dry calcareous soil" undoubtedly refer to gypsum. Beds of gypsum, however, may be recognized after attention has been directed to their peculiarities. Gypsum flats have a soil that is whitish, chalky and friable. They commonly sound with a very characteristic hollow ring when pounded or stamped upon. Large flats, on valley-floors, frequently develop sink-holes, opening into ill defined subterranean water-channels. Small gypsum flats are frequently favored by burrowing rodents and they may be marked by an unusually large number of the mounds of these animals.

The plants found on beds of gypsum are of two sorts, those tolerating gypsum, and those demanding it. The tolerant species, which are numerous, are those of non-gypseous soils which also grow on gypsum and which, though perhaps less abundant on gypsum than elsewhere, seem generally unaffected by the differences of substratum. Of this group only a few, such as *Dyssodia pungens, Coldenia hispidissima, Condalia spathulata,* and *Condalia fasciculata,* may, perhaps, be more thrifty on gypsum than off.

Associated with the species that have spread on to gypseous areas from surrounding non-gypseous soils is the much smaller group of species which are never found beyond the margins of gypseous areas of soil. The most abundant and successful plants found on gypsum exposures commonly belong to this smaller second group of plants.

That there are species strictly confined to gypseous soils is manifest in all exposures of gypsum. In fact, it is often dramatically shown by their abrupt disappearance along the margins of those gypsum flats which are sharply circumscribed. I have seen *Dicranocarpus* abounding on a small flat and so scrupulously respecting the well defined gypsum-margin as to suggest a culture of the plant on a carefully tended garden plot. In northern San Luis Potosí, where species of *Flaveria* and *Sartwellia* are not only confined to gypsum but commonly even abound on it, they frequently color gypsum-flats yellow and permit one to recognize these exposures of gypsum miles away on a distant hillside. Another example of the dramatic way in which species refuse to transgress gypsum-boundaries is found in the behavior of two species of *Fouquieria* growing north of Mohovano, Coahuila. One of these species is frequent on gypsum flats while the other replaces it on the surrounding non-gypseous soils. In a few cases I observed the shrubs growing near one another with interlocking branches, but *F. Shrevei* was always rooted

in gypsum and *F. splendens*, beyond an abrupt gypsum boundary, always rooted in non-gypseous soil.

That there are plants which appear to seek out gypsum and are confined to it is well shown by my experiences in the eastern foothills of the Sierra de las Cruces, Coahuila. Here on a large series of gypsum exposure I found a well developed gypsophilous florula containing species of *Notholaena, Sporobolus, Drymaria, Dicranocarpus, Nama* and *Haploesthes*. Searching out the widely scattered gypsum exposures of the region, with the help of Mr. Robert Stewart, a geologist very familiar with the area, we failed to find any of them that did not bear at least *Nama Stewartii* or *Haploesthes Greggii*. These species grew on gypsum and nothing but gypsum, and showed an almost incredible ability to find widely scattered exposures of gypsum, even the isolated ones and those with a few square yards of surface. Only obligate gypsophily and very successful powers of dissemination can explain the remarkable behavior of these plants.

That there is a group of plants which repeatedly seek out gypsum is further shown by a comparison of the lists of those species found restricted to gypsum in widely separated parts of northern Mexico. The most extensive gypsum deposits which I have examined are those forming the great plains between Matehuala and Cedral, in northern San Luis Potosí. Here are found the following gypsophiles:

Muhlenbergia villiflora
Drymaria lyropetala
Nerisyrenia gracilis
Dalea filiciformis
Nama canescens
Dicranocarpus parviflorus
Sartwellia humilis
Flaveria anomala

About 70 miles west of Matehuala, in northern Zacatecas, gypsum exposures near Sierra Hermosa have the following plants restricted to them:

Nerisyrenia gracilis
Phacelia gypsogenia
Dicranocarpus parviflorus
Sartwellia humilis
Nama hispidum var. *gypsicola*

In southeastern Coahuila, about 70 miles north of Matehuala, the following species were found confined to a gypsum flat just north of La Ventura:

Muhlenbergia villiflora
Nerisyrenia gracilis
Dicranocarpus parviflorus
Thelesperma scabridulum
Sartwellia humilis
Flaveria anomala
Nama hispidum var. *gypsicola*

Nearly 250 miles northwest of La Ventura, in western Coahuila near the southeastern corner of Chihuahua, gypsum flats are frequent between

Mohovano and Laguna del Rey. Here there is a well developed gypsophilous flora containing the following:

Selinocarpus Purpusianus — *Petalonyx crenatus*
Drymaria elata — *Nama Purpusii*
Nerisyrenia Castillonii — *Dicranocarpus parviflorus*
Fouquieria Shrevei — *Sartwellia mexicana*

Over 75 miles northwesterly from the Mohovano-Laguna del Rey area there are gypsum flats south of Jimenez, Chihuahua, bearing the following gypsophiles:

Phacelia gypsogenia *Dicranocarpus parviflorus* *Sartwellia mexicana*

About 75 miles north of Leguna del Rey in western Coahuila, gypseous ridges near Laguna del Jaco produce the following:

Muhlenbergia villiflora — *Nerisyrenia Castillonii*
Sporobolus Nealleyi — *Phacelia gypsogenia*
Sartwellia sp.

East from Laguna del Jaco, in the eastern foothills of the Sierra de las Cruces, there is a well developed gypsophilous florula containing the following:

Notholaena bryopoda — *Nama Stewartii*
Sporobolus Nealleyi — *Dicranocarpus parviflorus*
Drymaris lyropetala — *Haploesthes Greggii*

Further north in western Coahuila, over 100 miles north of Laguna del Rey and about 60 miles south of the Big Bend of the Rio Grande, there are gypsum flats at Castillon containing the following gypsophiles:

Sporobolus Nealleyi — *Nama Stewartii*
Nerisyrenia Castillonii — *Phacelia gypsogenia*
Loeselia Havardii — *Dicranocarpus parviflorus*
Sartwellia puberula

At each of the eight widely separated localities just mentioned, the plants listed were confined to gypsum. A comparison of the lists shows the combinations in which the various gypsophiles are associated in the several floristic areas represented. The presence of various species, frequently with several of the same associates, in widely separated gypsum exposures, is evidence that gypsophily is no matter of individual preference nor chance local association. Only the same fundamental requirements could force the species I have listed to foregather repeatedly and always within the confining limits of scattered gypsum exposures. The behavior of these plants is that of an old and established fraternity. This is also suggested by the fact that all the species of such well marked genera as *Dicranocarpus* and *Sartwellia* are gypsophilous

and is further indicated by the fact that such genera as *Nerisyrenia*, *Drymaria* and *Nama* all have groups of species characterized by gypsophily.

Thus far we have been concerned with the behavior of gypsophiles on exposures of gypsum or on soil mixtures evidently containing a high percentage of gypsum. As has been stated, examination of such deposits shows that certain species repeatedly occur on these deposits and fail to transgress their boundaries when these latter are sharply defined. Gypseous soils, however, may contain varying proportions of gypsum, and gypsum deposits may be partially or wholly covered by a mantle of non-gypseous soil of varying thicknesses, spread by water flowing from slopes beyond the gypsum-boundary.

My observations indicate that a gypsum flat overlaid with a fine completely non-gypseous soil, derived either from calcareous or igneous rocks, is practically devoid of gypsophiles when the non-gypseous mantle becomes as much as an inch in thickness. Sometimes an unbroken overlay of half that thickness appears to be an effective barrier to gypsophilous plants. Since gypsophiles show no particular aversion to non-gypseous material when a certain amount of gypsum is also available, as demonstrated by their frequent presence on mixed soils, and since it would seem that the deep roots of mature gypsophiles would have little difficulty in reaching gypsum through a thin overlying non-gypseous mantle, one can only conclude that the absence of gypsophiles on mantled gypsum is in some way associated with an inability of their seeds to germinate or their seedlings to become established in a completely non-gypseous surface layer of soil.

It is not uncommon to find gypsophiles in mixed soils containing sufficient gypsum characteristically to whiten the soil. Such soils, however, obviously contain a high percentage of gypsum. Observation of the gypsophilous florulas found on mixed soils discloses an obvious correlation between the decrease in number of gypsophiles, both as to individuals and as to species, and the decrease in the evident gypsum-content of these soils. This would indicate that the various gypsophiles differ in the minimum amounts of gypsum they require. This is a subject that merits the attention of an ecologist who can supplement his studies with soil analyses.

While most soils reveal their gypsum content by their pale coloration, there are soils which, though probably containing gypsum, give little or no evidence of the fact superficially. In some cases this is the result of mixing gypsum in a dark-colored soil, mixing in organic material, or masking the pale coloration of gypsum by abundant soil moisture. In

a few cases I have observed gypsophiles growing on soils which I could not identify as gypseous, though I strongly suspect that they are so.

While only chemical analyses will finally settle the matter, a surprisingly strong case of circumstantial evidence can be presented for the presumed occurrence of gypsum in nondescript soils where gypsophytes are found. As an illustration of this, a small terrace adjoining a salt-marsh at Hermanas, Coahuila, may be taken. Here, on a kind of light-colored though not pallid clay, which I did not recognize as gypseous, I found concentrated and localized a number of unusual plants, among which were the following:

Drymaria lyropetala	*Sartwellia mexicana*
Euphorbia astyla	*Thelesperma ramosius*
Nerisyrenia Castillonii	*Aplopappus Johnstonii*
Nama serpylloides var. *velutina*	*? Gaillardia multiceps*

Among this group of plants, the presence of the *Drymaria* and the *Nerisyrenia* is especially noteworthy, for these plants have been discovered elsewhere only on gypsum and are very marked gypsophiles. Habitat data are not at hand for all the available collections of the *Sartwellia,* but most of these are definitely known to have come from gypseous soil, and, from collateral evidence, a gypsum substratum can be confidently assumed for the rest. Hence among the plants congregating on the small terrace near Hermanas there are three species, which, if we may judge from their behavior elsewhere, might be taken as good indicators of gypseous soil. If the small terrace at Hermanas is gypseous, we have a reason for the remarkable concentration of rare plants in this small area. There is, indeed, evidence for believing that all of them are gypsophiles. It would not be surprising if the new *Thelesperma,* found only at Hermanas, proved to be gypsophilous. The genus *Thelesperma* has reacted to gypsum elsewhere; *T. scabridulum* is a marked gypsophile and is known only from a single gypsum flat in southern Coahuila. Among the other new plants found near Hermanas were the *Nama* and the *Aplopappus.* These, and the rare *Euphorbia,* I subsequently found a second time on the saline flat west of Cuatro Cienegas. It is interesting to note that near the margin of this saline flat, not far from where I found the *Nama,* the *Aplopappus* and the *Euphorbia,* I found colonies of *Nama Purpusii,* which is a characteristic gypsophile in the extensive gypsum flats, further west, about Laguna del Rey, where, incidentally, the *Euphorbia* has also been found. I am inclined, also, to attach significance to the fact that near the *Nama, Aplopappus* and *Euphorbia* at Cuatro Cienegas, I found a remarkable new species of *Nerisyrenia* (*N. incana*). Of the four other species

of this genus, three are marked gypsophiles. The odds, therefore, are in favor of *N. incana* also being gypsophilous. The presence of the gypsophilous *Nama Purpusii* in its vicinity seems to make this very probable. In any case, there are reasons for suspecting that gypsum is present west of Cuatro Cienegas. This appears to be the reason why the three rare plants of the supposed gypseous terrace at Hermanas should again appear together, sixty miles to the westward, in the saline flats near Cuatro Cienegas. The rare species localized on the terrace at Hermanas behave, individually and as a group, as gypsophiles. As gypsophiles their presence together, congregated on the small terrace at Hermanas, is understandable if the soil at that particular locality is gypseous. I believe that the congregation of these species indicates the presence of gypsum in the soil, and I am confident that soil analyses would substantiate my faith in the indicator value of these species.

If the localities near Hermanas and Cuatro Cienegas have gypseous soils, they are localities of interest. At both of them, the soils, in addition to their suspected gypsum content, evidently contained large amounts of other salts. Near Cuatro Cienegas the putative gypsophiles were actually associated with pronounced halophytes, such as *Distichlis, Monanthochloe, Suaeda, Atriplex* and *Allenrolfea.* This is the only locality at which I have found possible gypsophiles associating with pronounced halophytes. This would suggest that perhaps some gypsophiles, with their basic requirements of gypsum satisfied, can grow in mixed soils rich enough in other salts to support halophytic plants as well.

Some authors have referred to the plants found growing on gypsum as "halophytes." This is incorrect. If the conventional definition of halophyte, "a plant growing on soils impregnated with salt or alkali," can be stretched to include gypsophiles (plants of calcium sulphate), I do not see why the term can not be made entirely meaningless by including the plants of calcium carbonate, the calciophiles, as well. While some gypsophiles do appear to tolerate concentrations of salt and alkali and might be termed "halophytic gypsophiles," most of them grow on beds of gypsum where the concentrations of salt and alkali are frequently even lower than in the average of desert soils. Beds of gypsum do not produce the common and distinctive plants of salt and alkali flats. With adjacent non-gypseous slopes and flats, they share in the common and widespread species of the region, and their peculiar species have been recruited from among this class of plants. Perhaps the gypsophiles average a bit more succulent, but as a class they are not otherwise dis-

tinguished superficially from the common widely ranging desert plants growing with them on and about gypsum exposures.

Gypsophiles may belong to genera also containing species of common unspecialized desert plants, and even to genera containing more than one gypsophilous species, but only exceptionally do they belong to groups containing halophytes. In their basic requirements and in their phyletic relations gypsophiles and halophytes are fundamentally different. The few exceptions are of interest. The genus *Frankenia* is generally recognized to be an old group and has species widely scattered in the various desert regions of the world. Though most of its species are marked halophytes, the genus does contain some recognized gypsophiles, the two in America being confined to the plateau desert of northern Mexico and to the adjoining, physiographically similar, area to the north. The genus *Sporobolus,* which has a gypsophile in *S. Nealleyi,* also contains some marked halophytes. As a group, however, it is more characteristic of arid regions rather than of halophytic situations. Perhaps also to be included here is an aberrant and curious species of *Atriplex, A. reptans,* recently discovered on a flat at the base of a gypseous ridge near Laguna del Jaco, Coahuila. Should this *Atriplex* prove to be gypsophilous, it will be the only Mexican member of that great group of halophytes, the Chenopodiaceae, which is confined to gypseous soils.

It is natural to expect that, if gypsophily is markedly developed in northern Mexico, evidences of it should be found among the plants in the adjoining and physiographically similar parts of the United States. Casual notes in the literature and habitat-data on herbarium specimens suggests that there are a number of gypsophiles in the United States which do not extend south to the Mexican border. I know of only two localities north of the border at which the plants on a gypsum habitat have been described. Both are in New Mexico. Their flora is similar to that which I have described from Mexico.

Probably the most famous deposit of gypsum in the United States is the so called "White Sands" of New Mexico. In a recent account of these gypsum dunes, F. W. Emerson, Ecology **16**: 226–233 (1935), lists 57 species as growing in the gypsum sand. Among the species listed are: *Sporobolus Nealleyi, Nerisyrenia linearifolia, Nama (Andropus) carnosum, Dicranocarpus parviflorus,* and *Sartwellia Flaveriae.* The *Sporobolus* and *Dicranocarpus* are very definitely restricted to gypsum or gypseous soils in Mexico. The *Nama* is closely related to a group of Mexican gypsophiles, and away from the White Sands is known only from two collections in northern Culberson County, Texas. This latter area is a region of very extensive gypsum deposits, exposures of gypsum

fifty feet thick having been reported in the bluffs of Delaware Creek where this *Nama* has been collected. The *Nerisyrenia* was first collected on the bluffs of Delaware Creek, and has been subsequently found in various parts of adjacent southeastern New Mexico where Wooton & Standley, Fl. New Mex. 270 (1915), report it as a plant of "gypsum soils." It is closely related to the Mexican gypsophile *N. gracilis*. Away from the White Sands the *Sartwellia* has been collected repeatedly in gypseous soil and is probably gypsophilous as are the other, all Mexican, members of its genus. Hence at the White Sands we have growing on gypsum a number of species that are either specifically identical or are closely related to Mexican gypsophiles. Evidence indicates that the latter group may be as strictly confined to gypseous soils as are their Mexican relatives. Other gypsophiles, representing floristic elements not extending into Mexico, are probably also present on the White Sands. Very likely among these are *Selinocarpus lanceolatus, Frankenia Jamesii,* and *Pseudoclappia arenaria* (*"Clappia suaedaefolia"*).

The flora of some extensive gypsum flats, lying beyond the San Andreas Mts. and west of the White Sands, have recently been described by R. S. & I. F. Campbell, Ecology **19**: 572–577 (1938). In their account of the "Vegetation on gypsum soils of the Jornada Plain, New Mexico," they state that only eight phanerogams were found on the gypsum flats described; namely, *Ephedra Torreyana, Sporobolus Nealleyi, Pappophorum Wrightii, Oenothera Hartwegii, Gaura coccinea, Solanum Jamesii, Sartwellia Flaveriae,* and *Dicranocarpus parviflorus*. Except for the *Ephedra,* the *Solanum,* and the *Sartwellia,* which extend scarcely if at all into Mexico, any of these species may be expected on gypsum flats south of the boundary. Of the list only the *Pappophorum, Gaura* and *Solanum* are unreported from the White Sands. Concerning the eight species on the Jornada Plain the authors state that only the *Sporobolus* and the *Gaura* "appear to be limited to the gypsum soils." This must refer only to the areas on the Jornada Plain having maximum gypsum concentration. Both the *Sporobolus* and *Dicranocarpus* are characteristic gypsophiles in Mexico, and *Sartwellia Flaveriae* gives evidence elsewhere of sharing gypsophily with its Mexican congeners. At the three localities where I have seen the *Sporobolus* in Mexico it was confined to concentrated gypsum. The *Dicranocarpus* and the Mexican species of *Sartwellia,* on the other hand, though abounding on gypsum, frequently grow on mixed soils. I have no doubt that the behavior of these gypsophiles at the Jornada is similar to that I have observed in Mexico.

The study of the florulas of the two gypsum beds in New Mexico, just

mentioned, and of all available bits of information concerning the plants found on gypsum-soils in the Southern Great Plains Province, seems to indicate that gypsophily is largely confined there to groups of species recognizable as "southern" or "Mexican" elements in the flora. The plateau deserts of northern Mexico seem to be a center for gypsophiles and perhaps even a center from which they may have spread northward. In any case Texas and New Mexico appear to be a promising field for the study of gypsophiles in the United States. Many promising sites for such studies are described in R. W. Stone's "Gypsum deposits of the United States," U. S. Geol. Surv., Bull. **697**: 1–336 (1920).

ENUMERATION OF SPECIES

In the following catalogue I have listed systematically those plants of the plateau deserts of northern Mexico which are gypsophiles or are suspected gypsophiles. Because of their close relationships with certain Mexican gypsophiles, several gypsophilous species confined to Texas and New Mexico have also been included. Under each species treated I have cited collections examined. Most of these are in the Gray Herbarium (G). Some, however, are from the U. S. National Herbarium (US), and represent portions of a loan kindly sent me by the curator, Dr. W. R. Maxon. Dr. J. R. Swallen has not only critically determined the two grasses, but has also supplied me with a list of the collections by which they are represented in the National Herbarium. On his authority I have included these among the specimens cited.

Notholaena bryopoda Maxon, Proc. Biol. Soc. Wash. **18**: 205 (1905).

NUEVO LEON: base of the Sierra de San Lorenzo, chalky banks, 7500 ft., Nov. 7, 1907, *Pringle 8802* (G, ISOTYPE). COAHUILA: foothills of the Sierra de la Cruces west of Santa Elena Mines, confined to gypsum, locally abounding on flats and on banks of arroyos, about 5500 ft., Aug. 13, 1940, *Johnston & Muller 243* (G).

On the gypsum flats about a mile west of Santa Elena Mines this fern is localized and very common on gypsum. It grows on gypsum flats and on the banks of ravines cut through them, commonly forming dense clumps up to a meter in diameter. In its obvious restriction to gypsum and in its great abundance and vigorous growth on that substratum, it gives every evidence of being a gypsophile. Mr. C. A. Weatherby, who is monographing *Notholaena,* knows of only one other collection of this well marked species, the type-collection made nearly forty years ago in the mountains of southern Nuevo Leon, 15–20 miles south of Doctor Arroyo and not far from the Tamaulipas boundary. At this locality in

Nuevo Leon the fern was collected on "chalky banks." Since dry gypsum is "chalky" and since the fern was confined to gypsum near Santa Elena Mines, I believe it may be accepted as more than merely probable that the original material of *N. bryopoda* was found on a gypsum bank. This fern is probably gypsophilous.

Muhlenbergia villiflora Hitchc. N. Am. Fl. **17**: 470 (1935).

Tamaulipas: "Cañon de las Minas et Victoria inter Michiguana et Tanquecillos," *Karwinsky 1012* (US, frag. of type). San Luis Potosí: Charcas, *Lundell 5440* and *Whiting 786* (US); 6 mi. north of San Vicente, gypseous soil, 1938, *Johnston 7615* (G, US). Nuevo Leon: Galeana, bank of stream, *Chase 7689* (G, US); near Pablillo, edge of cienega, 1940, *Shreve & Tinkham 9749* (G). Coahuila: 6 mi. north of La Ventura, gypsum flat, 1938, *Johnston 7642* (G, US); 10 mi. east of Fraile, with *Stipa*, abounding on floor of valley, 1938, *Johnston 7305* (G, US); gypseous ridge east of Laguna del Jaco, 1940, *Johnston & Muller 1074* (G, US).

I am indebted to Dr. J. R. Swallen for the identification of this species and for data on the specimens of it represented at Washington. Most of the collections cited have been incorrectly identified as "*M. Thurberi.*"

This species is definitely confined to gypsum at four out of the nine stations at which it is known. At these stations the plant behaved as a marked gypsophile. Although the nature of the soil was not noted, the local abundance of the grass in the valley between Carneros Pass and Fraile might well be caused by the presence of gypseous soil. Various gypsophiles have been collected near Pablillo. Gypseous soils are common and widely distributed in northern San Luis Potosí and are to be expected near Charcas. I believe that this grass is gypsophilous.

Sporobolus Nealleyi Vasey, Contr. U. S. Nat. Herb. **1**: 57 (1890).

Coahuila: gypseous ridge east of Laguna del Jaco, 1940, *Johnston & Muller 1073* (G); foothills of Sierra de las Cruces west of Santa Elena Mines, gypsum flats, 1940, *Johnston & Muller 247* (G); Castillon, gypsum flat, 1940, *Johnston & Muller 1268* (G).

Texas: Monahans, Ward Co., very sandy belt, *Silveus 759* (US); Monahans, alkali flat, *Silveus 784* (US); 15 mi. south of Stanton, ? Midland Co., *Tharp 5000* (US); Screw Bean, Reeves Co., Sept. 1893, *Nealley 2305* (G, US); valley of the Pecos, *Wright 727* (G). New Mexico: 35 mi. south of Torrance, Lincoln Co., 1909, *Wooton* (US); San Ysidro, *Arséne 19040* (US); Manzano Nat. Forest, near White Well no. 2, Torrance Co., Forest Service no. 39515, legit *Talbot* (US); near Suwanee, 1906, *Wooton* (US); Arroyo Ranch near Roswell,

Chaves Co., *Griffiths 5759* (G, US); Jornado Range Reserve, in caliche east of Middle Well, Forest Service no. 49290, legit *Schoeller & Campbell 462* (US); on the white sands, Dona Ana Co., *Wooton 160* (G, US).

Where I have seen this grass in Mexico it was very obviously confined to gypsum. Hitchcock, Manual of Grasses, 406 (1935), states that it is a plant of "gypsum sands" in Texas and New Mexico. Wooton & Standley, N. Mex. Agr. Experiment Station Bull. **81**: 84 (1911), state that "it never occurs on anything but 'gyp' soils," being "found only on soils containing large quantities of gypsum." Many of the localities in Texas and New Mexico, represented by the specimens cited above, are those where other gypsophiles have been obtained, and most of them are in areas in which extensive gypsum exposures are known. All the evidence indicates that the species is a marked gypsophile.

Atriplex reptans Johnston, Jour. Arnold Arb. **22**: 111 (1941).

COAHUILA: flats at the base of the gypsum ridge east of Laguna del Jaco, 1940, *Johnston & Muller 1080* (G) and *1081* (G, TYPE).

This remarkable *Atriplex* was locally very abundant in a narrow belt at the base of a gypsum ridge. It was the dominant and by far the most conspicuous plant in the scant flora at this locality. It was not seen elsewhere. The species is probably gypsophilous.

Selinocarpus Purpusianus Heimerl, Oesterr. Bot. Zeitschr. **63**: 353 (1913).

COAHUILA: 16 mi. south of Laguna del Rey, road to Mohovano, confined to gypsum flats, *Johnston 7807* (G); Sierra del Rey, 1910, *Purpus 4505* (G, ISOTYPE).

This plant was uniformly associated with *Fouquieria Shrevei* and *Petalonyx crenatus* in the region about Laguna del Rey, and like these species always growing on gypseous soil. The plant is a marked gypsophile.

The genus *Selinocarpus* has more than one gypsophile. *Selinocarpus lanceolatus* Wooton is definitely gypsophilous. It is known only from the White Sands of New Mexico and to the south, in the great gypsum area in northeastern Hudspeth County, Texas. *Selinocarpus Palmeri* Hemsl., known only from San Lorenzo de la Laguna, Coahuila, may possibly be another.

Anulocaulis leiosolenus (Torr.) Standley, Contr. U. S. Nat. Herb. **12**: 373 (1909).

TEXAS: Tornillo Creek, Brewster Co., 1883, *Havard* (US); 5¼ mi. E. of Terlingua, 1938, *Cory 30251* (G); bluffs of Delaware Creek, 1881,

Havard 87 (G); Millers Bros. Ranch, Culberson Co., 1928, *Cory 1532* (G).

The type of this species is given as collected by Parry in the "Great Canyon of the Rio Grande, 70 miles below El Paso, in gypseous soil." This is probably the canyon of the Rio Grande at the southeast corner of Hudspeth County, Texas. Gypseous soils are known in Tornillo Creek, and, of course, gypsum occurs in unusual abundance in northern Culberson County where Havard and Cory have collected the plant. The species is almost certainly a gypsophile. The plants of Nevada, which have been referred to *Anulocaulis leiosolenus* represent a well marked, undescribed species.

Drymaria lyropetala Johnston, Jour. Arnold Arb. **21**: 68 (1940).

San Luis Potosí: 3.5 km. south of Cedral, gypsum flats, 1938, *Johnston 7594* (G, type); 63 km. south of Matehuala, gypsum flats, 1938, *Johnston 7513* (G). Coahuila: 1 mi. south of Hermanas, locally common in heavy alkaline soil, 1938, *Johnston 7064* (G); foothills of the Sierra de las Cruces west of Santa Elena Mines, local on gypsum flats, 1940, *Johnston & Muller 241* (G).

This species is probably a pronounced gypsophile. At three of the four localities at which it has been collected it was definitely confined to gypsum. As has been discussed earlier in this paper, the locality at Hermanas is probably gypseous also.

Drymaria elata Johnston, Jour. Arnold Arb. **21**: 68 (1940).

Coahuila: 10 km. south of Laguna del Rey, local in gypseous silt, 1938, *Johnston 7823* (G, type); Sierra del Rey, 1910, *Purpus 4496* (G).

This species is endemic to the region about Laguna del Rey where I found it only on gypseous soils. I believe it may be accepted as a marked gypsophile.

Drymaria suffruticosa Gray, known only from San Lorenzo de la Laguna, Coahuila, is a close relative of *D. elata* with which it may share gypsophily. Various gypsophiles have been collected at San Lorenzo.

Nerisyrenia gracilis, sp. nov.

Planta humilis perennis multicaulis gracilis, maturitate pilis stellatis sparse vestitas grisella; caulibus gracilibus numerosis 1–2 dm. longis decumbentibus saepe longiramosis; foliis linearibus 2–5 cm. longis saepe 1–1.5 mm. raro ad 2 mm. latis; sepalis oblongis ad 6 mm. longis 1.5 mm. latis; petalis albis ad 9 mm. longis obovatis supra medium ad 4.5 mm. latis deinde basim versus in unguiculum ad 1.5 mm. longum ad 1.3 mm. latum margine denticulatum contractis; pedicellis 5–10 mm. longis

decurvatis vel recurvatis; siliquis 1–2 cm. longis curvatis paullo compressis ca. 1 mm. altis et 1.25 mm. crassis, in racemis breviter pedunculatis terminalibus 1–5 cm. longis gestis; stylo 2.5–3 mm. longo; ovulis 60–100; seminibus compresse ellipsoideis ad 0.8 mm. longis ca. 0.5 mm. latis.

SAN LUIS POTOSÍ: 38 mi. south of Matehuala, gypsum flat, 1938, *Johnston 7509* (G); 5 mi. south of Cedral, gypsum plain, 1938, *Johnston 7525* (G); 2 mi. south of Cedral, gypsum plain, 1938, *Johnston 7583* (G, TYPE); 6 mi. north of San Vicente, gypseous soil, 1938, *Johnston 7616* (G). ZACATECAS: Hac. de Sierra Hermosa, gypsum bank, 1938, *Johnston 7402* (G). COAHUILA: 6 mi. north of La Ventura, gypsum flat, 1938, *Johnston 7638* (G).

This well marked species most suggests *N. linearifolia* of gypsum soils in New Mexico and Texas, from which it differs in being a low, spreading and herbaceous, rather than an erect, tall, frutescent plant, and in having shorter less exserted inflorescences, smaller corollas, longer styles, and weakly compressed fruits. The plant is a marked gypsophile. All the known collections of the species were obtained from gypseous soils, and at all the known stations it was confined to that substratum.

Nerisyrenia linearifolia (Wats.) Greene, Pittonia **4:** 225 (1900).

NEW MEXICO: White Sands, Otero Co., *Wooton 158* (G, US) and *Wooton 2781* (US); Lakewood, Eddy Co., 1909, *Wooton* (US); plains 35 mi. south of Torrance, Lincoln Co., 1909, *Wooton* (US); road between Fort Sumner and Roswell, sandy roadside, *Nelson 11311* (G). TEXAS: bluffs of Delaware Creek, Culberson Co., 1882, *Havard 221* (G, TYPE).

In their Flora of New Mexico, Wooton & Standley, Contr. U. S. Nat. Herb. **19:** 270 (1915), state that this is a plant of "gypsum soils." The type-locality in western Texas, near the New Mexico line, is in an area of extensive gypsum deposits. The species, like its Mexican relative, *N. gracilis,* is evidently a gypsophile.

Nerisyrenia Castillonii Rollins, Contrib. Dudley Herb. **3:** 181 (1941).

COAHUILA: 16 mi. south of Laguna del Rey, gypsum plain, 1938, *Johnston 7814* (G); 1 mi. south of Hermanas, dry heavy alkaline soil on terrace, *Johnston 7067* (G); gypseous ridges east and south of Laguna del Jaco, 1940, *Johnston & Muller 1078* and *1099* (G); Castillon, gypsum flat, *Johnston & Muller 1264* (G, TYPE).

This newly described species resembles *N. camporum* var. *angustifolium* Coult., but is a perennial and has subterete rather than compressed fruit. Except those from near Hermanas, the above-cited speci-

mens were all obtained from soils recognized as gypseous. The soil at this locality, as discussed earlier in this paper, is probably gypseous also. The species is apparently gypsophilous.

Nerisyrenia incana Rollins, Madroño **5**: 132 (1939).

COAHUILA: 4 mi. west of Cuatro Cienegas, alkaline flats, 1938, *Johnston 7130* (G, TYPE).

This species may be gypsophilous, as are all the other species of the genus, save only *N. camporum*. Plants found near it, in and adjacent to the saline flats, seem to indicate the soil at this locality may be gypseous.

Dalea filiciformis Robins. & Greenm. Proc. Am. Acad. Sci. **29**: 382 (1894).

NUEVO LEON: foothills below Pablillo, 15 mi. sw. of Galeana, abundant over small areas in pinyon-belt, 1934, *Muller 530* (G). SAN LUIS POTOSÍ: 2 mi. south of Cedral, gypsum plain, 1938, *Johnston 7585* (G); 35 mi. south of Matehuala, gypsum flats, 1938, *Johnston 7516* (G); Villar, limestone hills, 1893, *Pringle 5472* (G, TYPE); Minas de San Rafael, 1910, *Purpus 4834* (G). AGUASCALIENTES: Aguascalientes, *Rose & Haye 6204* (G) and *Rose & Painter 7706* (G). HIDALGO: El Salto, dry calcareous soil, 1904, *Pringle 11959* (G); Tula, 1905, *Rose, Painter & Rose 8315* (G). FEDERAL DISTRICT: above Santa Fe, thin gravelly soil, *Pringle 8522* (G). PUEBLA: near El Riego, Tehuacan, *Rose & Painter 10010* (G); *Purpus 1204* (G); vicinity of Puebla, Acatzinco, *Arséne 3570* (G).

At the two localities where I have collected this plant, south of Cedral and Matehuala, it grew only in pure gypsum. The behavior of the plant at these localities was that of a pronounced gypsophile. Most of the collections above cited have no habitat data. It is to be noted, however, that Pringle's collection from Hidalgo is given as from "dry calcareous soil," a descriptive phrase which various botanists have applied to gypseous soils. The collection from Nuevo Leon, from the area about Pablillo where various gypsophiles have been collected, probably came from gypsum, and I suspect that most of the collections cited from central Mexico may have come from that substratum. The plants from the state of Puebla are more fruticulose, more branched and have fewer leaflets than the other material cited. Perhaps they should not be included in the above enumeration of specimens.

Euphorbia astyla Engelm. ex Boiss. in DC. Prodr. **15**^{2}: 40 (1862).

TEXAS: Pecos County, July 21, 1928, *Cory 1960* (G).

Coahuila: 1 mi. south of Hermanas, heavy alkaline soil, 1938, *Johnston 7060* (G); 3 mi. west of Cuatro Cienegas, saline flats, 1938, *Johnston 7135* (G); 3 mi. south of Cuatro Cienegas, salt land, 1939, *White 1924* (G); Sierra del Rey, 1910, *Purpus 4512* (G). Durango: valley of the Nazas, April 15, 1847, *Gregg 457a* (G, type).

This plant is probably a halophytic gypsophile. The associates of this species have been discussed earlier in this paper.

Frankenia gypsophila Johnston, Jour. Arnold Arb. **20:** 237 (1939).

San Luis Potosí: 6 mi. north of San Vicente, local on gypseous soil, 1938, *Johnston 7614* (G, type).

This remarkable species is known only from the type-collection which was obtained from a colony localized on gypseous soil. One of its closest American relatives, *F. Jamesii* Torr. of Texas, New Mexico and Colorado has been collected on gypsum and may also be gypsophilous.

Petalonyx crenatus Gray ex S. Wats. Proc. Am. Acad. **17:** 358 (1881–82).

Coahuila: San Lorenzo de la Laguna, 1880, *Palmer 853* (G, type); Sierra del Rey, sandy plains, 1910, *Purpus 4466* (G); 16 mi. south of Laguna del Rey, confined to gypsum flats, 1938, *Johnston 7808* (G); about 30 mi. south of Sierra Mojada, 1937, *Wynd 769* (G); 21 mi. west of El Oro, 1939, *White 2006* (G).

The collections by Purpus and by Wynd come from the region about Laguna del Rey where I have observed the plant and found it confined to gypseous soils. There is probably gypsum at San Lorenzo de la Laguna. Several of the species found confined to gypsum in the area between Mohovano and Laguna del Rey are otherwise known only from collections made by Palmer at San Lorenzo de la Laguna.

Fouquieria Shrevei Johnston, Jour. Arnold Arb. **20:** 238 (1939).

Coahuila: road to Mohovano, 16 mi. south of Laguna del Rey, confined to gypsum flats, 1938, *Johnston 7815* (G, type); San Lorenzo de la Laguna, 1880, *Palmer 2001* (G).

This species was observed at various places between Mohovano and Laguna del Rey and was always confined to gypseous soils. I believe that the species may be accepted as a marked gypsophile.

Loeselia Havardii Gray, Proc. Am. Acad. Sci. **19:** 87 (1883).

Texas: 12 mi. south of Persimon Gap, Brewster County, *Cory 18709* (G).

Chihuahua: Presidio del Norte [Ojinaga], March 1881, *Havard*

247 (G, TYPE). COAHUILA: Castillon, confined to gypsum flats, 1940, *Johnston & Muller 1263* (G).

The species was clearly confined to gypsum at Castillon. Gypseous soils are frequent about Ojinaga and in the Big Bend area of Texas where the species has also been collected. I believe that the species is gypsophilous.

Nama Stewartii Johnston, Jour. Arnold Arb. **22:** 114 (1941).

COAHUILA: south base of Picacho de San José, southeastern foothills of Sierra de las Cruces, gypsum flats and cliffs, 1940, *Johnston & Muller 814* (G, TYPE); eastern foothills of Sierra de las Cruces west of Santa Elena Mines, gypsum flats, 1940, *Johnston & Muller 228* (G); Castillon, confined to gypsum flats, 1940, *Johnston & Muller 1271* (G); between Carrizo and Carricito, gypseous ridge, 1940, *Johnston & Muller 159* (G); Picachos Colorados, slope at west end of cliffs, 1940, *Johnston & Muller 139* (G).

The material from the Sierra de las Cruces and that from Castillon was collected in pure gypsum, and that from between Carrizo and Carricito came from pale evidently gypseous soil. Sr. Tirso Castillon informs me that gypsum crops out from under the red cliffs of the Picachos Colorados near the place where I collected the plant. The species is a marked gypsophile.

Nama Havardii, of the Big Bend area, in Brewster County, Texas, is most closely related to *N. Stewartii.* It occurs in a region containing gypseous soil and some of the collections of the plant are given as from that substratum. The species is to be expected on the Mexican side of the Rio Grande and may prove to be a gypsophile.

Nama Purpusii Brandegee, Univ. Calif. Publ. Bot. **4:** 186 (1911).

COAHUILA: Mohovano, 1910, *Purpus 4562* (UC, TYPE); 16 mi. south of Laguna Del Rey, on road to Mohovano, gypsum plain, 1938, *Johnston 7812* (G); 5 mi. west of El Oro, 1939, *White 2003* (G); 4 mi. west of Cuatro Cienegas, 1938, *Johnston 7141* (G).

Gypsum deposits are very common between Mohovano and El Oro and the collections of Purpus and White may well have come from gypsum, for in the same region, south of Laguna del Rey, I observed the plant only on gypsum flats. The collection from west of Cuatro Cienegas came from local colonies of the plant in barren grayish silt among the desert scrub not far from the edge of the salt-marsh in which a number of suspected halophytic gypsophiles were found. The plants from near Cuatro Cienegas, hence, probably grew in gypseous soil. I believe that *Nama Purpusii* is gypsophilous.

Nama stenophyllum Gray is a close relative of *N. Purpusii*. It is known only from about 25 mi. northeast of Parras, about the base of the Parras Mts., and near Viesca. Like its relative, the species may be gypsophilous.

Nama canescens C. L. Hitchc. Amer. Jour. Bot. **26**: 345 (1939).

SAN LUIS POTOSÍ: 38 mi. south of Matehuala, gypsum plain, 1938, *Johnston 7510* (G, TYPE); 2 mi. south of Cedral, gypsum plain, 1938, *Johnston 7584* (G).

Both of the known collections of this species were discovered on concentrated gypsum. The plant is a marked gypsophile.

Nama serpylloides Gray var. **velutina** C. L. Hitchc. Amer. Jour. Bot. **26**: 342 (1939).

COAHUILA: 2 mi. west of Cuatro Cienegas, bank of very alkaline soil, edge of salt-marsh, 1938, *Johnston 7126* (G); 1 mi. south of Hermanas, dry heavy alkaline soil on terrace near salt-marsh, 1938, *Johnston 7063* (G, TYPE).

I believe that this plant is a halophytic gypsophile. The cited material, all that is known of the variety, was collected before I had come to recognize gypsum as a special habitat. The chalky mounds on which the *Nama* was growing west of Cuatro Cienegas were probably gypseous. My reasons for believing that the locality near Hermanas was also gypseous have been discussed earlier in this paper.

Nama hispidum Gray var. **gypsicola**, var. nov.

A forma typica differt caulibus gracilibus 5–18 cm. longis 0.5–1.5 mm. crassis valde depressis sparse strigosis; foliis acutiusculis linearibus 0.7–1 mm. latis 5–12 mm. longis pilos rigidos sparsos gerentibus margine incrassatis; limbo corollae 5–7 mm. diametro.

ZACATECAS: Hac. de Sierra Hermosa, prostrate on gypsum banks, 1938, *Johnston 7406* (G). COAHUILA: 6 mi. north of La Ventura, rare on gypsum flats, plant depressed-spreading, corolla blue-purple, Sept. 13, 1938, *Johnston 7633* (G, TYPE).

The very slender depressed strigose stems and the very narrow elongate sparsely strigose leaves readily separate these two collections from all the many specimens of *N. hispidum* and varieties as represented in the Gray Herbarium. The two collections were both localized on gypsum and, though collected over a hundred miles apart, are so similar in aspect as well as in details, that they might pass as parts of a single collection. Hitchcock, Amer. Jour. Bot. **26**: 347 (1939), commented

on their peculiarities but gave them no name. They evidently represent a marked gypsophilous variation of the species.

Nama carnosum (Wooton) C. L. Hitchc. Amer. Jour. Bot. **26**: 345 (1939).

NEW MEXICO: White Sands of Dona Ana County, *Wooton 164* (US, TYPE).

TEXAS: bluffs of Delaware Creek, Culberson Co., *Havard 15* (G); Millers Ranch, Culberson Co., gypsum ridge, June 17, 1928, *Cory 2291* (G).

This is a marked gypsophile. The presence of the species on the White Sands and on the gypsum ridge near Millers Ranch as well as its presence on the bluffs of Delaware Creek, where thick beds of gypsum are exposed, is indicative of its soil requirements.

Nama flavescens Brandegee is a Mexican relative of *N. carnosum*. It has been collected near Parras and near San Lorenzo de la Laguna in Coahuila, and near Cedros in Zacatecas. Various pronounced gypsophiles have been collected near San Lorenzo and near Cedros. The species may possibly be a gypsophile.

Phacelia gypsogenia, sp. nov.

Planta erecta rigida 2–4.5 dm. alta infra medium simplex supra medium ramulos ascendentes 1–2 dm. longos gerens glandulifera hispidula; caulibus hispidulis minute adpresseque villosulis viscidis basim versus 3–5 mm. crassis; foliis inferioribus sub anthesi delapsis; foliis mediis et superioribus numerosis viridibus sparse hispidulis viscidis 3–6 cm. longis 1–1.5 cm. latis conspicue irregulariter lobatis; lobis foliorum saepe utroque 5–7 irregulariter eroso-dentatis vel inciso-lobulatis; spicis numerosis densis multifloris solitariis vel geminatis, maturitate saepe ca. 5 cm. longis sed non raro duplo vel triplo longioribus ad 8 mm. latis; lobis calycis oblanceolatis vel late oblanceolatis hispidulis glanduliferis, ad anthesim 3–4 mm. longis et 1–1.5 mm. latis, fructiferis ad 5 mm. longis et 1.2–1.8 mm. latis; calycibus fructiferis subglobosis; corolla subtubulari dilute lavendulacea marcescente ca. 5.5 mm. longa imam ad basim 1.5 mm. crassa, supra (infra lobis) 2.5 mm. crassa; limbo ca. 3 mm. diametro; lobis ascendentibus vel stricte ascendentibus glaberrimis ad 2 mm. longis et latis apice rotundis margine erosis vel raro integris; filamentis ca. 1 mm. supra basim corollae affixis ca. 7 mm. longis longe exsertis; appendiculis staminalibus ad 0.8 mm. longis basim versus latioribus (ca. 0.3 mm. latis) deinde apicem versus gradatim angustioribus, basi abrupte contractis rotundis; stylis 7–8 mm. longis ad 2–2.5 mm. supra basim connatis et sparse hispidulis deinde liberis

et glabris; ovario supra medium dense hispidulis; capsula subglobosa ad 2.5 mm. longa glandulifera supra medium sparse antrorse hispidula; seminibus 4, foveolatis ca. 2.5 mm. longis et 1.5 mm. latis, dorse convexis haud corrugatis, ventre excavatis, marginem versus carinae medialis prominentibus et nuculae latus inferius versus aliquantum tumulosis.

ZACATECAS: Hac. de Sierra Hermosa, local on gypsum banks, 1938, *Johnston 7403* (G). CHIHUAHUA: 5 mi. south of Jimenez, gypsum flat, 1938, *Johnston 7843* (G). COAHUILA: gypseous ridge east of Laguna del Jaco, 1940, *Johnston & Muller 1072* (G); Castillon, on gypsum flats, 1940, *Johnston & Muller 1266* (G, TYPE).

This very distinctive plant belongs to the group of *Phacelia integrifolia* Torr., in which it is characterized by its stiff erect habit, grayish viscid hispidulous stems, irregularly much dissected elongate leaves, small fruits, small hispidulous subglobose calyx, and small subtubular glabrous corollas.

The plant is a marked gypsophile. At all the four localities at which it has been found it very definitely grew on gypsum and was obviously confined to gypseous soil.

Aplopappus Johnstonii Blake, Proc. Biol. Soc. Washington **54:** 18 (1941).

COAHUILA: 1 mi. south of Hermanas, dry heavy alkaline soil, 1938, *Johnston 7066* (G); 4 mi. west of Cuatro Cienegas, alkaline flat, 1938, *Johnston 7131* (G).

Though the substratum of the plants was not recognized as gypseous when the specimens were collected, as has been discussed earlier in this paper, I now believe that the plant was growing in gypsum-containing soil. I believe that this bizarre species is a gypsophile.

Dicranocarpus parviflorus Gray, Mem. Am. Acad. Sci. n.s. **5:** 322 (1854).

SAN LUIS POTOSÍ: 35 mi. south of Matehuala, gypsum flat, 1938, *Johnston 7514* (G); 2 mi. south of Cedral, gypsum flat, 1938, *Johnston 7588* (G); near Salado, gypsum plains, 1939, *Shreve 9353* (G); Catorce, alkaline plain, 1934, *Lundell 5736* (US). ZACATECAS: Sierra Hermosa, gypsum banks, 1938, *Johnston 7407* (G); Hac. de Cedros, on flats, a garden pest, 1908, *Lloyd 173* (US). DURANGO: Mapimi, cultivated fields, *Palmer 537* (G, US). COAHUILA: 6 mi. north of La Ventura, gypsum plain, 1938, *Johnston 7641* (G); 16 mi. south of Laguna del Rey, gypsum plain, 1938, *Johnston 7805* (G); Sierra de las Cruces, foothills west of Santa Elena Mines, gypsum flats,

1940, *Johnston & Muller 242* (G); Castillon, gypsum flat, 1940, *Johnston & Muller 1271* (G). CHIHUAHUA: 5 mi. south of Jimenez, gypsum flat, 1938, *Johnston 7842* (G); plain below San Carlos, Oct. 1852, *Parry 70* (G).

TEXAS: plains between the Guadalupe Mts. and the Pecos, Oct. 20, 1849, *Wright 348* (G, TYPE; US). NEW MEXICO: San Andreas Mts., ? Dono Ana Co., on gypsum soil, 1914, *Wooton* (US); White Sands, 1904, *Wooton 2545* (US).

This species, constituting the monotypic genus *Dicranocarpus,* gives every evidence of being a pronounced gypsophile. Most of the specimens cited above are definitely known to have been collected on gypsum and most of the remaining few are from localities where gypsum deposits are known to occur. Curiously, the plant at Cedros (where numerous gypsophiles have been collected) and at Mapimi, is noted by the collectors as becoming a weed in cultivated fields.

Thelesperma scabridulum Blake, Jour. Wash. Acad. **25:** 317 (1935).

COAHUILA: endemic on a gypsum flat 6 mi. north of La Ventura, *Lundell 5728* (US, TYPE) and *Johnston 7646* (G).

This well marked species is known only from one locality. It is there confined to a gypsum flat.

Thelesperma ramosius Blake, Proc. Biol. Soc. Washington **54:** 20 (1941).

COAHUILA: one mile south of Hermanas, heavy alkaline soil, 1938, *Johnston 7059* (G, TYPE).

This plant occurs with a number of other unusual species localized on heavy soil near Hermanas. As discussed earlier in this paper, the soil at this locality, though originally not recognized as such, is almost certainly gypseous. The plant, I believe, is a gypsophile.

Flaveria anomala Robins., Proc. Am. Acad. Sci. **27:** 178 (1892).

SAN LUIS POTOSÍ: plains about Matehuala, 1904, *Pringle 8801* (G); 35 mi. south of Matehuala, gypsum flats, 1938, *Johnston 7515* (G); 14 mi. south of Matehuala, local, silty valley floor, 1938, *Johnston 7518* (G); north of Matehuala, gypsum plain, 1938, *Johnston 7524* (G); plains at Venegas, 1890, *Pringle 3669* (G, TYPE); near Salado, gypsum plain, 1939, *Shreve 9354* (G). COAHUILA: 6 mi. north of La Ventura, gypsum plain, *Johnston 7647* (G). NUEVO LEON: near Pablillo, floor of cienega, 1940, *Shreve & Tinkham 9754* (G).

This plant abounds on the gypsum flats north and south of Matehuala.

Gypsum almost certainly occurs about Pablillo, for several gypsophiles have been found localized in that area. The present species appears to be a marked gypsophile.

Flaveria oppositifolia (DC.) Rydb., while apparently not always confined to gypseous soils, seems to luxuriate on this substratum and at some localities is actually restricted to it. Further observations on the soil-preference of this species are needed.

Gaillardia multiceps Greene, Bull. Torr. Bot. Cl. **24**: 512 (1897).

COAHUILA: 1 mi. south of Hermanas [ca. 46 mi. south of Sabinas], local on dry heavy alkaline soil, 1938, *Johnston 7062* (G); on the desert 25 mi. southwest of Sabinas [road to Hermanas], 1936, *Wynd & Muller 209* (NY, US).

TEXAS: Ables, Hudspeth Co., 1927, *Cory 2756* (G). NEW MEXICO: dry plains east of Carlsbad, Eddy Co., 1924, *Standley 40293* (US). ARIZONA: south of Woodruff, Navajo Co., 1892, *Wooton* (TYPE, US); Holbrook, Navajo Co., 1901, *Ward* (NY, US); Holbrook, 1896, *Zuck* (Mo); Camp No. 6, Little Colorado River [ca. 15 mi. w. of Holbrook], 1852, *Sitgreave Exped.* (G); between Winslow and Flagstaff, Coconino Co., 1934, *McKelvey 4535* (G).

Through the kindness of Prof. Marion Ownbey, of the State College of Washington, I am able to cite above the specimens which his student, Miss Susann Fry who is monographing *Gaillardia*, has provisionally referred to *G. multiceps*. Prof. Ownbey writes me that the two Mexican collections closely resemble one another, but differ markedly in habit and general appearance from all the other collections cited.

Near Hermanas the plant is associated with a number of gypsophilous species. Earlier in this paper I have discussed the reasons for believing that the soil was gypseous at this locality. I have no information as to the soil 20 miles further north in Coahuila, where Wynd & Muller also collected the same form. It is interesting to note, however, that Cory collected the species at Ables, in northeastern Hudspeth County, Texas, where he has obtained various markedly gypsophilous species, and that Standley has obtained the only known New Mexican collection of the species west of the Pecos and north of the Texan boundary in a region where extensive gypsum deposits are known. In New Mexico, Texas and Coahuila the species behaves suspiciously like a gypsophile. Should this plant prove to be a gypsophile, its distribution would appear unique. I know of no gypsophilous plant which ranges in eastern New Mexico, western Texas and adjacent Mexico, and also occurs in northern Arizona.

Sartwellia mexicana Gray, Proc. Am. Acad. Sci. **19:** 34 (1883).

COAHUILA: Monclova, *Palmer 687* (G, TYPE; US); 1 mi. south of Hermanas, dry heavy alkaline soil, 1938, *Johnston 7058* (G); San Lorenzo de la Laguna, 1880, *Palmer 683* (G, US); 4 mi. north of Parras, silty soil in bottom of valley, 1938, *Johnston 7705* (G); road to Mohovano, 16 mi. south of Laguna del Rey, gypsum plain, 1938, *Johnston 7818* (G); Carro de Cypriano [near Mohovano], 1901, *Purpus 4476* (G, US). CHIHUAHUA: 5 mi. south of Jimenez, gypsum flat, 1938, *Johnston 7844* (G); between Chapo and Mula, gypseous soil, 1940, *Johnston & Muller 1438* (G).

I believe that this species is restricted to gypsum or mixed gypseous soils. The plant grows on mixed gypseous soil north of La Mula. The soils in which I found it near Hermanas and Parras are probably similar. Gypsum is common in the Laguna del Rey – Mohovano area in which Purpus collected the plant. Various gypsophiles have been collected near San Lorenzo where Palmer found the plant.

Sartwellia puberula Rydb. N. Am. Fl. **34:** 141 (1915).

COAHUILA: Castillon, gypsum flat, 1940, *Johnston & Muller 1267* (G).

At Castillon this plant abounded on a gypsum flat and was obviously confined to it. It agrees with the original description of *S. puberula* Rydb., collected by Parry on "the plains below San Carlos" (where he collected *Dicranocarpus*), south of the Rio Grande in northeastern Chihuahua where gypsum deposits have been reported. The species may be no more than a puberulent variety of *S. mexicana* Gray.

Sartwellia humilis, sp. nov.

Planta perennis humilis; caulibus numerosis decumbentibus vel laxe ascendentibus 5–15 cm. longis simplicibus vel ascendenter ramosis, internodiis 8–15 mm. longis; foliis linearibus glabris quam internodiis 1–2-plo longioribus 10–45 mm. longis 0.5–1 mm. latis carnosulis; capitulis campanulatis in corymbos terminales saepe ca. 15 mm. diametro densos aggregatis; tegulis 5 late elliptico-obovatis herbaceis 2 mm. latis ad 3 mm. longis cum nervis 5–9 nigrescentibus ornatis, margine anguste scariosis; receptaculo obcampanulato 4–5 mm. alto 5–6 mm. crasso apice rotundo glabro; corollis ligularibus ad 5, limbo obovato trinervato ad 1.5 mm. longo et ad 1 mm. lato apice emarginato (bidentato); tubo gracillimo ca. 1 mm. longo; corollis tubulosis ca. 20, tubo ad 1.4 mm. longo, faucibus ad 1 mm. longis, lobis 5 ad 0.5 mm. longis triangularibus; stylo lobato ad 7 mm. longo lineari apicem versus latiore, antheris ca. 0.9 mm. longis appendiculis oblongis ad 0.15 mm. longis terminalibus

ornatis; achaeniis nigris 5-costatis paullo curvatis ca. 1.2 mm. longis apice setas 5 et paleas 5 basim versus connatas proferentibus, paleis oblongis 0.5–0.8 mm. longis supra medium latioribus apice rotundis et laceratis, pilis 0.6–0.9 mm. longis barbellatis.

SAN LUIS POTOSÍ: 4 mi. south of Cedral, gypsum plain, 1938, *Johnston 7567* (G, TYPE). ZACATECAS: Hac. de Sierra Hermosa, gypsum bank, 1938, *Johnston 7405* (G); Cedros, calcareous hills, *Lloyd & Kirkwood 145* (G); Cedros, hills, very calcareous soil, 1907, *Lloyd 14* (US). COAHUILA: 6 mi. north of La Ventura, gypsum plain, 1938, *Johnston 7634* (G). LOCALITY UNKNOWN: Vanegas to Saltillo road, alkaline plain, 1934, *Lundell 5719* (US).

This plant is related to *S. mexicana* but differs in having numerous very short spreading stems and slightly larger heads. A low spreading compact plant, it differs greatly in appearance from the erect, loose, long-stemmed northern *S. mexicana*. I know this species only from gypsum soil. Lloyd reports his collection from "very calcareous soil" and Lundell gives his as from an "alkaline plain." Since botanists frequently allude to gypseous soils in such terms, I am confident they also collected the plant on gypsum. I believe this plant is gypsophilous.

Sartwellia Flaveriae Gray, Pl. Wright. **1**: 122. *t. 6* (1852).

NEW MEXICO: Roswell, Chaves Co., 1900, *Earle 340* (G, US); White Mts., Lincoln Co., 1897, *Wooton 383* (G, US); hills south of road from Rentfrow Ranch to "upper crossing of malpais," Socorro Co., 1923, *Eggleston 19432* (US); White Sands, Otero Co., 1904, *Wooton 2619* (G); 7½ mi. east of Carlsbad, Eddy Co., 1935, *Cory 17615* (G); Pecos Valley near Texas line, Eddy Co., 1901, *Bailey 743* (US). TEXAS: vicinity of Pecos City, Reeves Co., 1913, *Rose & Fitch 17905* (US); Dale, *Havard 92* (US); Screw Bean, 1889, *Nealley 691* (US); Pecos County, 1933, *Cory* (G); common on the Rio Pecos, *Havard 95* (G); western Texas, 1849, *Wright 386* (G, US).

The genus *Sartwellia* consists of three Mexican species, all of which appear to be gypsophilous, and this, the original and most distinct member of the genus, is known only from Texas and New Mexico. It has been collected on gypsum, and its presence in southeastern New Mexico, where gypsum deposits are widely distributed, and in the Pecos Valley of Texas where gypsum also occurs, suggest that *S. Flaveriae* may favor gypseous soils if not actually confined to that substratum. All the species of *Sartwellia,* therefore, give evidences of gypsophily.

Haploesthes Greggii Gray, Mem. Amer. Acad. Sci. n.s. **4**: 109 (1849).

COAHUILA: near Cienega Grande, northeast of Parras, May 18, 1847,

Gregg 68 (G, TYPE); Sierra de la Paila, 8000–9000 ft., 1910, *Purpus 4708* (G, US); south base of Picacho de San José, eastern foothills of Sierra de las Cruces, confined to gypsum exposures, frequent, shrubby, 6–24 in. tall, 1940, *Johnston & Muller 813* (G); eastern foothills of Sierra de las Cruces, near Santa Elena Mines, confined to gypsum flats, frequent, 6–24 in. tall, 1940, *Johnston & Muller 244* (G).

In the eastern foothills of the Sierra de las Cruces, near Santa Elena Mines, and near the base of the Picacho de San José, this plant is locally frequent on exposures of gypsum and confined to them. The plant was so definitely confined to gypseous soils at these localities that I strongly suspect that the other localities at which it has been found have gypseous soils also.

This typical form of the species was first collected by Gregg northeast of Parras at what is now called "Cienega Grande." It is a slender, small, shrubby plant becoming 2 feet tall. Its heads are elongate and similar in form to those of the var. *texana,* but they do not become dusky or blackish green in drying as in the northern variety. Its ligulate flowers are also larger, being usually 3.5–4.5 mm. long and 2–3 mm. wide, rather than 2.5–3.5 mm. long and 1–2.5 mm. wide as in the Texan plant. The elongate tegules of typical *H. Greggii* and its var. *texana* are coriaceous and usually become rugulose in drying.

The recently described *H. robusta* Johnston, Jour. Arnold Arb. **22**: 121 (1941), from the salt-flats near Cuatro Cienegas, is most closely related to the typical form of *H. Greggii,* having the elongate heads and the coriaceous rugulose elongate tegules which do not become dusky in drying. It is, however, a very much more robust plant, coarser in all its parts and not at all shrubby. Gypseous soils are suspected near Cuatro Cienegas and, accordingly, there is a possibility that *H. robusta* may be gypsophilous.

Haploesthes Greggii var. **texana** (Coulter), comb. nov.

Aplopappus texanus Coulter, Contr. U. S. Nat. Herb. **1**: 40 (1890).

CHIHUAHUA: Presidio del Norte [Ojinaga], July 1852, *Parry 68* (G).

TEXAS: Chisos Mts., Brewster Co., 1889, Nealley 203 (US, TYPE); near Lajitas, Brewster Co., infrequent, 1–2 ft. tall, yellow, 1937, *Warnock 727* (US); Presidio Rio Grande [Eagle Pass], Sept.–Oct. 1848, succulent, indicating salt, *Wright 404* (G, US); 10 miles east of Rankin, Upton, 1936, *Cory 15392* (G); Odessa tank, Staked Plains, Ectos Co., 1881, *Havard 96* (G, US); Sweetwater, Nolan Co., 1913, *Wooton* (US); 8 mi. west of Claremont, Kent Co., 1935, *Cory 13846*

(G); O'Donnell, Lynn Co., 1931, *Reed 3436* (US); Estelline, Hall Co., rocky soil, *Reverchon 3991* (G, US); Gambeles Ranch, Armstrong Co., gypseous bank of canyon, 1918, *Palmer 13997* (US); Breckenridge, Stephens Co., open plains, 1925, *Ruth 1271* (US). NEW MEXICO: Round Mt., along Tularosa Creek, Otero Co., July 20, 1905, *Wooton* (US). OKLAHOMA: Hollis, Harmon Co., grassy valley, 1913, *Stevens 1076* (G, US); Antelope Hills, gypsum hills, Roger Mills Co., 1853, *Bigelow* (G); Shattuck, Ellis Co., moist grassy place, 1914, *Clifton 3200* (G).

This northern plant differs from typical *H. Greggii* in its heads, which average smaller and are characteristically dusky or dusky-green when dry. Its ligules average much smaller.

Several of the above cited collections are stated to have been collected on gypsum and most of them are from areas in which large gypsum-deposits and gypseous soils are known. The plant is probably a gypsophile.

Haploesthes Greggii var. **multiflora**, var. nov.

Planta a varietate genuina differt capitulis hemisphaericis multifloris latioribus quam latis, tegulis laevioribus suborbiculatis; ligulis florum marginalium ad 5 mm. longis et 2.5–3 mm. latis.

COAHUILA: Saltillo, common on bottom-lands in good soil, very woody plant with bright yellow flowers, found only in its prescribed area, 1898, *Palmer 206* (G, TYPE); mountains east of Saltillo, 1880, *Palmer 649* (G, US). NUEVO LEON: Monterey, 1924, *Orcutt 1278* (US); open pine-forest [5 mi. NW of Pablillo] 14 mi. south of Galeana, 1940, *Shreve & Tinkham 9755* (G).

This eastern variety of *H. Greggii* is readily recognized by its broad hemispherical heads which contain nearly twice as many florets as do those of other forms of the species. Its ligules become larger than those in the typical form.

I have no information as to whether or not this plant is gypsophilous. It is to be noted, however, that Shreve & Tinkham obtained the plant near Pablillo, in the area in which such gypsophiles as *Muhlenbergia villiflora, Dalea filiciformis* and *Flaveria anomala* have been collected. Furthermore, the note by Palmer, "found only in its prescribed area" is most suggestive of the restricted occurrence of most gypsophilous plants.

ARNOLD ARBORETUM,
HARVARD UNIVERSITY,

THE COMPARATIVE MORPHOLOGY OF THE ICACINACEAE
II. VESSELS

I. W. Bailey and R. A. Howard

With six plates

INTRODUCTION

In anatomically primitive xylem of dicotyledons and monocotyledons, the vessel members resemble scalariform-pitted tracheids in size, form and structure, but differ from them in dissolving certain of their pit membranes during the later stages of tissue differentiation. In the secondary body of less specialized dicotyledons, the fusiform initials of the cambium and the scalariform vessel members are relatively long and have extensively overlapping ends. Furthermore, the vessels tend to be isolated from one another and to be more or less uniformly distributed throughout the wood.

The most significant lines of specialization in the vessels of dicotyledons involve (1) conspicuous changes in the size and form of the vessel members, (2) structural modifications of the scalariform pits and the scalariform perforations and (3) a not uncommon tendency for the vessels to aggregate in multiples, chains or clusters. During the first of these major trends of specialization, the vessel members shorten and frequently increase in diameter. As the vessel members shorten and widen, their perforated facets become less and less acutely, and ultimately transversely, oriented. In other words, with increasing specialization of the vessels, their constituent cells become less and less tracheidlike in size and form, Bailey and Tupper (2) and Frost (4 and 5). These changes in the vessels are closely synchronized with concomitant modifications of the cambium, the fusiform initials becoming shorter and elongating less after anticlinal divisions, Bailey (1). In addition, the salient trends of specialization in the size and form of the vessel members frequently are more or less closely paralleled by structural modifications of the perforations and of the pitting of the vessels. The numerous scalariform perforations of the less specialized types of vessels are ultimately replaced by a single, large, elliptical or circular perforation, and the scalariform pits of the non-perforated parts of the vessel members are superseded by smaller pits having first an opposite and subsequently an alternating arrangement, Bailey and Tupper (2), Frost (6).

THE STRUCTURE OF THE VESSELS IN THREE MAJOR CATEGORIES OF THE ICACINOIDEAE

These salient trends of specialization are well exemplified in the vessels of the Icacinaceae and serve to differentiate the Icacinoideae into various levels of increasing structural modifications. For purposes of the following discussion, it is advisable to segregate the Icacinoideae into three major categories:

I. Vessels of Both Primary and Secondary Xylem with Scalariform Perforations

Trilacunar Icacineae

Anisomallon	Cassinopsis	Ottoschulzia
Apodytes	Dendrobangia	Pennantia
Calatola	Emmotum	Pittosporopsis
Citronella*	Oecopetalum	Platea
		Poraqueiba

II. Vessels of the Secondary Xylem with Scalariform — Porous Perforations

Trilacunar Icacineae

Cantleya	Grisollea	Stemonurus
Discophora	Lasianthera	Urandra
Gastrolepis	Leptaulus	
Gonocaryum	Medusanthera	

III. Vessels of the Secondary Xylem with Simple Porous Perforations

A. *Unilacunar Icacineae*

Alsodeiopsis	Lavigeria	Merrilliodendron
Desmostachys	Leretia	Pleurisanthes
Humirianthera	Nothapodytes	Rhaphiostylis
Icacina	Mappia	Rhyticaryum

B. *Iodeae* (*Unilacunar*)

Hosiea	Mappianthus	Polyporandra
Iodes	Natsiatum	

C. *Sarcostigmateae* (*Unilacunar*)

Sarcostigma

D. *Phytocreneae* (*Unilacunar*)

Chlamydocarya	Phytocrene	Pyrenacantha
Miquelia	Polycephalium	

In the first of these three categories of the Icacinoideae, the vessels of both the primary and the secondary body are provided with scalariform perforations. The vessel members of the secondary xylem are in general

*In dealing with the genera of the Icacineae we are following the terminology proposed by Howard (7).

very long with more or less extensively overlapping ends, *Figs. 28–31.* The perforated facets of the vessel members tend to be set at a relatively acute angle to the long axis of the vessels. Furthermore, the pitting of the non-perforated facets — except that between vessels and tracheids — is transitional between scalariform and circular-opposite, *Figs. 11–13 and 20–24.*

On the contrary, in the third category of the Icacinoideae, the vessels of the secondary xylem have simple porous perforations, and not infrequently the vessels of the metaxylem are likewise devoid of scalariform perforations. The vessel members are comparatively short and their perforated facets are set either at right angles or at relatively large angles to the long axis of the vessels, *Figs. 47–50.* The non-perforate pits between vessels and between vessels and parenchymatous cells are of the circular-alternating type, *Figs. 17–19.* The walls of the vessels are relatively thick and fused pit apertures are of common occurrence.

The vessel members of the second category, *Figs. 32–45,* of the Icacinoideae are transitional in size, form and structure between the morphologically primitive vessel members of the first category and the highly specialized ones of the third category. Both scalariform and simple-porous perforations occur not only in different vessels of the secondary xylem and in different parts of the same vessel, but also not infrequently at opposite ends of the same vessel element, *Fig. 32.* However, the ratio of scalariform to porous perforations fluctuates greatly in different genera and species and at times in different parts of the same stem.

TABLE I

Length of Vessel Members in Microns

Categories of Icacinoideae	Highest average	Mean of all averages	Lowest average
I. scalariform	2150	1470	950
II. scalariform — porous	1500	1050	700
III. A. porous	750	590	450
III. B–D. porous	600	470	300

As indicated in Table I, the vessel members of Group II are of transitional lengths; the longest-celled species of this group having lengths comparable to the mean of all species in Group I, and the shortest-celled species having averages comparable to the maxima of Group III. The vessel members likewise are of transitional form; those of certain species having perforated facets that are acutely oriented as in Group I and other species having facets that are set at larger angles to the long

axis of the vessels. The pits of the non-perforated facets of the vessels exhibit a wide range of variability, being at times transitional between scalariform and circular-opposite and between circular-opposite and circular-alternate, *Figs. 14–16 and 25–27.*

The vessels in the secondary xylem of most representatives of Group I are numerous, isolated from one another, and more or less uniformly distributed throughout the wood, *Figs. 1–3.*[1] True contacts between different vessels are of infrequent or sporadic occurrence except in certain species of *Pittosporopsis* and *Platea.* In Group III, on the contrary, aggregated vessels or "pore multiples" are of common occurrence, *Figs. 8–10.* As might be anticipated, the distribution of vessels in Group II is transitional and variable; certain species of *Cantleya, Fig. 4, Stemonurus, Fig. 6, Lasianthera, Leptaulus* and *Gonocaryum* exhibiting relatively few contacts between vessels, whereas species of *Discophora, Grisollea, Gastrolepis, Medusanthera* and *Urandra, Fig. 7,* tend to form more or less numerous tangentially, radially or irregularly oriented pore multiples.

Such facts as these demonstrate that there are salient trends of phylogenetic specialization in the vessels of the Icacinaceae which closely parallel those that occur in other families and in the dicotyledons as a whole. Although we have utilized but one of these trends, viz., in the perforations, for differentiating three major categories of the Icacinoideae, such an apparently arbitrary procedure serves to segregate this sub-family into three general levels of increasing structural specialization. That it does so is obviously due to the fact that the various phylogenetic changes in vessels tend in general to be more or less closely correlated.

It should be noted in this connection, however, that the various lines of evolutionary modification are by no means perfectly synchronized. One or more of them may be accelerated when others are retarded or *vice versa.* Furthermore, there are various localized modifications that are divergent from the main trends of phylogeny in vessels. The task of sub-dividing the three major categories of the Icacinoideae into minor levels of structural specialization is complicated by such factors as these. It should be recognized, in addition, that in dealing with minor sub-divisions of a family, where the quantitative and qualitative differences are slight, more attention must be devoted than heretofore to a careful study of the limits of variability within species and in different

[1]An appearance of paired vessels in these transverse sections of the wood is due to the fact that certain of the vessels are cut at a level where the ends of the vessel members overlap.

parts of the same plant, Bailey and Faull (3). In the case of tracheary cells, fairly reliable clues regarding the probable limits of structural variability may be secured by comparing the first-formed secondary xylem, obtained from herbarium specimens, with wood cut from mature stems. The vessel members increase more or less in length and in diameter, *Figs. 4–5,* in passing from the first-formed to the later-formed secondary xylem, and the more conspicuous fluctuations in the form of the vessel members and in the character of their perforations and pits are commonly associated with such variations in size.

DETAILS OF STRUCTURAL SPECIALIZATION WITHIN THE THREE MAJOR CATEGORIES OF THE ICACINOIDEAE

Group I

The most primitive vessel members of the Icacinoideae occur in the metaxylem and first-formed secondary xylem of *Platea.* The long, slender, extensively overlapping vessel members of such species as *P. excelsa* Bl., *P. latifolia* Bl., *P. parviflora* K. & V. and *P. philippinensis* Merr. have a strikingly tracheidlike form, *Fig. 28.* In tangential view, they have very acutely beveled facets, whereas in radial view they have parallel sides and relatively blunt ends. The numerous scalariform perforations either are distributed throughout the overlapping radial facets of the contiguous vessel members or grade into scalariform pits which they closely resemble in size and form. They are actually membraneless scalariform pits with more or less reduced borders. Where the bordering areas of the secondary wall are much reduced, the pit apertures are large and their outlines nearly coincide with those of the perforations in the primary walls. The intervening "bars" between the pit apertures are slender. On the contrary, where the borders are fully developed the pit apertures are narrower and the intervening bars are wider. The pitting between adjacent vessels is dominantly scalariform, *Figs. 11 and 12,* with occasional transitions to opposite, whereas that between the vessels and the parenchymatous cells fluctuates between scalariform, *Fig. 20,* and opposite.

The smallest vessels of the first-formed secondary xylem of *Platea* are but slightly wider than the largest tracheids, and the larger vessels rarely exceed 50 μ in diameter, whereas those of the later-formed wood may at times attain tangential diameters of from 90–140μ and radial dimensions of from 130–210μ. These larger vessel members tend in general to retain a tracheidlike form. *Fig. 29,* in spite of their excessive lateral expansion during tissue differentiation, but some of them become

more or less spindle-shaped in radial view. The perforated facets tend to be less acutely oriented and the scalariform perforations become much extended transversely, viz. at right angles to the long axis of the vessel members. The non-perforate intervascular pits may also attain comparable dimensions, but usually are less extended or are replaced by two or more series of shorter scalariform or oblong pits, *Fig. 12*. The pitting between vessels and parenchymatous cells fluctuates between scalariform and opposite much as it does in the first-formed secondary xylem.

The most highly modified and least tracheidlike vessel members of the Group I Icacinoideae occur in the later-formed secondary xylem of *Emmotum, Fig. 31.* Those of *E. holosericeum* Ducke are relatively long, but the ratio of extensively overlapping cells is lower than in the case of comparable material of *Platea.* The vertically as well as transversely enlarged perforations and the broad intervening bars are reduced in number and are localized in a facet that tends to be oriented at relatively large angles to the long axis of the vessel. Where the vessel members overlap more extensively, their ends expand much less during tissue differentiation than do the intervening parts, and therefore extend beyond the broadly elliptical perforated facets as slender projections of varying lengths. The bordered pits in the non-perforate facets which adjoin those of the other vessel members or of parenchymatous cells are circular or elliptical and tend to be arranged in opposite seriation. Typical scalariform pitting is of sporadic or infrequent occurrence.

The narrower vessel members of the first-formed secondary xylem have more acutely oriented perforate facets and less abruptly tapered ends. Although the perforations are smaller and not infrequently more numerous than they are in the larger vessels of the older wood, they are sharply differentiated in size and form from the non-perforate pits. In certain cases, there appears to be a somewhat higher ratio of scalariform and transitional pitting, particularly in vessels in close proximity to the primary body.

The vessel members of the older wood of *Ottoschulzia cubensis* (Wright) Urb. are much smaller than those in comparable material of *Emmotum holosericeum* Ducke, and more nearly resemble those in the earlier-formed secondary xylem of that species. The perforations and broad intervening bars are reduced in number and are localized in a more or less inclined facet that subtends the slender tips of the vessel members. The enlarged perforations are in marked contrast to the small circular or elliptical pits in the non-perforate facets of the vessels.

The remaining representatives of the Group I Icacinoideae exhibit

various transitional stages of phylogenetic modification and various combinations of morphological specialization. The smaller vessel members of *Oecopetalum mexicanum* Greenm. & Thomps., and of *O. guatemalense* Howard, particularly those of the metaxylem and first-formed secondary xylem, have a primitive tracheidlike form and structure comparable to the conditions in *Platea*. The vessel members of the older wood differ, however, from those of comparable material of *Platea* in having a higher ratio of conspicuously tapered ends, i. e. in radial view. Furthermore, the perforations are less numerous and, in the case of the more extensively overlapping vessel members, are localized in a restricted part of the long acutely oriented radial facets. Structural transitions between perforations and scalariform pits are by no means of infrequent occurrence, but scalariform intervascular pitting is less conspicuously developed than in *Platea*. The vessel-parenchyma pits are dominantly scalariform and transitional, and have much enlarged apertures and reduced borders. Thus, they resemble the scalariform perforations in general size and form.

Somewhat similar vessel-parenchyma pitting, *Fig. 21,* occurs in *Poraqueiba sericea* Tul. and serves to differentiate this plant from *Ottoschulzia cubensis* (Wright) Urb. which was formerly included in *Poraqueiba*. It should be emphasized in this connection that the larger vessel members of *Poraqueiba* resemble those of *Ottoschulzia* and of *Emmotum* in having enlarged perforations, but they have broader and less abruptly tapered ends and the perforated facets are more acutely oriented.

The vessel members of the later-formed secondary xylem of *Pennantia* and of certain species of *Apodytes,* e. g. *A. dimidiata* E. Mey., have attained a form which is comparable to that encountered in *Ottoschulzia*. The perforations are localized in broadly elliptical facets, beyond which the more or less abruptly tapered ends of the cells project for varying distances, *Fig. 30*. However, the perforations differ from those of *Emmotum* and *Ottoschulzia* in having vertical dimensions that are not conspicuously greater than the diameters of the small circular bordered pits, and in being separated by slender intervening bars. In these plants scalariform pitting is likewise of somewhat infrequent or sporadic occurrence and has been replaced by numerous small circular or elliptical pits in opposite seriation.

The vessels of *Anisomallon clusiaefolium* Baill. and of *Calatola costaricensis* Standl. and *C. venezuelana* Pitt. also have narrow perforations and slender bars, but the perforations tend to be more numerous and to be localized in longer facets that are more acutely oriented. Further-

more, the vessel members are of more tracheidlike form in that their overlapping ends taper less markedly and abruptly than in the preceding plants. Although the non-perforate pits of the larger vessels are dominantly of the circular-opposite type, there is a higher ratio of vestigial scalariform and transitional pitting, *Fig. 22*. In our material of *Calatola costaricensis* Standl. and *C. venezuelana* Pitt., as also in that of *Dendrobangia boliviana* Rusby there is an unusually high ratio of abnormal reticulate perforations, *Fig. 23*. In such abnormal perforated facets, the smaller oblong or elliptical perforations have either transverse or diagonal seriations.

The vessel members of *Citronella* (including *Briquetina, Chariessa, Sarcanthidion* and *Villaresia*) and of *Apodytes* fluctuate considerably in size and form, in the number of perforations, in the width of the intervening bars, in the localization of the perforations in facets of varied orientations, and in the ratio of scalariform to opposite pitting, *Figs. 13 and 24*. In certain of these plants, as also in *Cassinopsis tinifolia* Harv., and *Pittosporopsis Kerrii* Craib., the smallest vessel members of the metaxylem and of the first-formed secondary xylem are of approximately as primitive a tracheidlike form and structure as those that occur in *Platea* and *Oecopetalum*.

Group II

There are two distinct types of transitions between scalariform and porous perforations in the Group II Icacinoideae. The perforations of *Leptaulus*, e. g. *L. daphnoides* Benth., *L. grandifolius* Engl., and *L. Zenkeri* Engl., fluctuate between 1–12 at each end of the vessel members, *Figs. 39–41*. Where the perforations are more numerous, they vary in form between scalariform, circular and "ephedroid." It is evident that as the perforations are reduced in number in the broader vessels of the later-formed wood, they become larger and are separated by wider intervening bars. Thus, in the genus *Leptaulus*, the simple porous type of perforation results primarily by reduction in the number, and a concomitant increase in size, of the individual perforations. Although the vessel members are relatively small, having diameters of only 45–75μ, in the old wood of *L. daphnoides*, they do not retain a tracheidlike form, *Fig. 39*. The perforations are localized in inclined facets that subtend the slender, abruptly tapered tips of the vessel members. The small, circular or elliptical, intervascular and vessel-parenchyma pits are loosely and somewhat irregularly distributed. Typical scalariform pitting tends to be restricted largely to the primary body.

In all of the other genera of the Group II Icacinoideae, the simple

porous condition arises from scalariform types by the elimination of the more or less numerous bars between the scalariform perforations; or, to express the matter ontogenetically, by the cells not forming such secondary wall thickenings during tissue differentiation. Many transitional stages in the elimination of the bars occur within the vessels of the same stem, *Figs. 34–36 and 38*. Furthermore, as previously stated, the ratio of scalariform and transitional to porous perforations fluctuates greatly not only within different species but also in different parts of the same plant. In general, the number of scalariform and transitional perforations tends to be somewhat higher in the first-formed than in the later-formed secondary xylem.

The highest ratios of scalariform and transitional perforations occur in the first-formed secondary xylem of various species of *Stemonurus*. The vessel members are relatively long and slender, and tend to have smoothly tapered ends. The perforations are localized in restricted areas of the overlapping ends of the vessel members and thus occur in facets that are acutely oriented, *Fig. 32*. The more or less infrequently occurring simple porous perforations are oblong or narrowly elliptical and correspond in size and form to the outlines of the complexes of scalariform or transitional perforations. As the vessel members increase in diameter in subsequently formed secondary xylem, their ends become more abruptly tapered and their perforations are localized in facets that are less steeply inclined. The simple porous perforations commonly are more numerous than in the first-formed secondary xylem and are oval, broadly elliptical or circular. The intervascular and vessel-parenchyma pitting fluctuates between scalariform, opposite and alternate and the ratios of scalariform and oblong to elliptical and circular pits vary considerably not only in different species but also in different parts of the same stem. Aggregations of vessels or pore multiples are of relatively infrequent or sporadic occurrence in most species of *Stemonurus, Fig. 6*.

On the contrary, the vessels of *Medusanthera* and of *Grisollea Thomassetii* Hemsl. tend to aggregate in small radially, diagonally or tangentially oriented clusters. There is a lower ratio of scalariform and transitional types of perforations in the vessels of these plants, even in those of the first-formed secondary xylem, *Figs. 34–36*. The form of the vessel members and of the simple porous perforations fluctuates between the first-formed and the later-formed secondary xylem much as it does in *Stemonurus*. Even in species which have relatively slender vessels in the later-formed secondary xylem, the vessel members have a high ratio of abruptly tapered ends and perforate facets that are set at relatively large angles to the long axis of the vessels, *Fig. 33*. The inter-

vascular and vessel-parenchyma pits are numerous and relatively small as in *Stemonurus,* but there appears to be a somewhat higher ratio of alternate pitting in *Medusanthera.*

The vessels of *Discophora, Gastrolepis, Urandra* and *Cantleya* may be differentiated from those of the preceding plants by the large size of their intervascular, *Fig. 14,* and vessel-parenchyma pits, *Fig. 26.* The latter pits vary considerably in size, form and orientation and tend to have more or less enlarged apertures. At times, particularly in the smaller vessels of the first-formed secondary xylem, they are scalariform and resemble the vessel-parenchyma pits that occur in *Oecopetalum* and *Poraqueiba* of the Group I Icacinoideae. The ratio of pits with conspicuously enlarged apertures fluctuates considerably in different species and not infrequently in different parts of the same stem. The intervascular pitting varies between scalariform, opposite and alternate, *Figs. 14 and 15.* The size and form of the vessel members, *Fig. 37,* also fluctuate considerably in different species and in different parts of the same plant, as do the size and form of the simple porous perforations, the ratio of scalariform, *Fig. 38,* to simple perforations, *Fig. 37,* and the number and size of the bars in the scalariform and transitional perforations. The vessels of *Cantleya corniculata* (Becc.) Howard have an isolated distribution, *Fig. 4,* whereas those of *Discophora, Urandra, Fig. 7,* and *Gastrolepis* tend to be aggregated in more or less conspicuous radially, diagonally or tangentially oriented clusters.

The vessels in herbarium material of *Lasianthera africana* Beauv. are isolated. The vessel-parenchyma pits are scalariform with enlarged apertures and thus resemble those that occur in the four preceding genera, but the intervascular pits are small and resemble those that occur in *Stemonurus* and *Medusanthera.* The vessels of *Gonocaryum* also have an isolated distribution and numerous small intervascular pits. However, the vessels of this genus differ from those of all of the preceding genera in the much modified and abnormal form of their scalariform perforations, *Figs. 43–45,* which frequently are vertically, diagonally, concentrically or irregularly, rather than transversely, oriented. The small simple porous perforations tend to be broadly elliptical or circular even in the vessels of the earlier-formed secondary xylem and are localized in small more or less inclined facets that subtend the abruptly tapered ends of the vessel members, *Fig. 42.* The intervascular and vessel-parenchyma pitting is transitional between circular-opposite and circular-alternate, *Fig. 27,* and typical scalariform pitting is of sporadic or vestigial occurrence except in close proximity to the metaxylem.

Group III

As shown in Table I, the vessel members of the Icacinoideae tend to shorten with increasing structural specialization of the vessels. That they tend to widen is indicated in Table II.

TABLE II

Diameter of Largest Vessels in Microns

Inner Secondary Xylem	Group I	Group II	Group III
Less than 40μ	50%	50%	9%
40–65μ	50%	50%	28%
More than 65μ	0%	0%	63%
Outer Secondary Xylem			
Less than 100μ	40%	22%	5%
100–125μ	44%	34%	10%
More than 125μ	16%	44%	85%

This tendency is detectable in the outer secondary xylem of the Group II Icacinoideae, but is not statistically demonstrable without additional data in the first-formed secondary xylem. On the contrary, it is clearly exemplified in both the inner and the outer secondary xylem of the Group III Icacinoideae. That the conspicuous enlargement of the vessels in the first-formed secondary xylem of Group III Icacinoideae is commonly associated with the acquisition of a scrambling or vinelike habit of growth is demonstrated in Table III. It occurs not only in the tribes Iodeae, Sarcostigmateae, and Phytocreneae, but also in scandent species of such genera of the unilacunar Icacineae as *Lavigeria, Leretia, Pleurisanthes* and *Rhyticaryum,* and to a lesser extent in certain species of *Humirianthera* and *Rhaphiostylis* which have a scrambling habit of growth. Therefore, in dealing with the Group III Icacinoideae, it is essential to differentiate between trends of specialization in plants of different habits of growth.

TABLE III

Diameter of Largest Vessels in Microns

Group III: Inner Secondary Xylem	Trees - Shrubs	Scrambling Shrubs	Vines - Lianas
Less than 40μ	35%	0%	0%
40–65μ	58%	33%	12%
More than 65μ	7%	67%	88%

In the arborescent and frutescent species of *Alsodeiopsis, Mappia* and *Nothapodytes,* the vessels tend to occur in radial clusters, *Fig. 8,* or at

times in more extensive, loose, radial grouping. The largest vessels of the first-formed secondary xylem fluctuate in diameter from 30–65μ, whereas those of the later-formed secondary xylem attain tangential diameters of from 80–170μ. Vestiges of scalariform perforations and of scalariform or opposite intervascular pitting are confined to the metaxylem. The vessel members, *Fig. 47,* vary considerably in form, those of smaller diameter having more acutely oriented perforate facets and less abruptly tapered ends. The vessels of *Desmostachys Vogelii* Stapf fluctuate similarly in size and in the form of their constituent cells, *Fig. 46,* but differ from those of the preceding genera in tending to occur in tangential, *Fig. 9,* rather than in radial groupings. There is, in addition, a much higher ratio of scalariform perforations in the metaxylem of both *Desmostachys Vogelii* Stapf and *D. Preussii* Engl. The vessels of *Merrilliodendron* are much reduced in number, but are of relatively large size, attaining diameters of from 70–90μ in the first-formed secondary xylem and as much as 250μ in the later-formed wood. The widely spaced vessels occur singly and in occasional tangentially, diagonally or radially oriented clusters. The pitted vessels of both the metaxylem and the secondary xylem have prevailingly porous perforations. The vessel members, particularly of the outer secondary xylem, have a much higher ratio of transversely oriented perforate facets, *Fig. 50.*

The young stems[1] from herbarium specimens of scrambling or vine-like Icacineae are either of normal structure or exhibit more or less conspicuous "anomalous" features. Thus, in our material of *Humirianthera ampla* (Miers) Baehni, *H. rupestris* Ducke, *Icacina Mannii* Oliv., *I. senegalensis* A. Juss., *Rhyticaryum elegans* Schellenb., and *R. onocarpum* Sch. & Lautb., the internodal parts of the stem have a nearly cylindrical form. The vessels of the secondary xylem, although exhibiting a tendency to occur in loosely organized tangential or concentric grouping as in *Desmostachys,* are more or less uniformly distributed around the stem. They attain maximal diameters of from 50–80μ. On the contrary, in comparable material of *Leretia, Pleurisanthes* and *Rhaphiostylis,* the secondary xylem frequently develops precociously upon opposite sides of the stem, i. e., between the orthostiches. The vessels of the secondary xylem, which attain diameters of from 65–120μ, tend to aggregate in the more rapidly growing sides of the stems. These tendencies towards "anomalous" types of growth are much exaggerated in the stems of various species of *Pleurisanthes,* which during subsequent growth assume a form similar to that of *Iodes ovalis* Bl., illustrated in

[1]Unfortunately, material from older stems of many of these plants is not available at present.

Fig. 7 of the preceding paper of this series. The precociously developed, large-vesselled secondary xylem differs, however, from that formed in comparable material of *Iodes ovalis* in having numerous strands of included phloem. In *Lavigeria salutaris* Pierre, the large-vesselled secondary xylem develops on all sides of the internode and is formed by successive cambia. There appears to be a much lower ratio of vestigial scalariform perforations in the metaxylem of *Lavigeria* and *Pleurisanthes* than in that of *Leretia, Rhaphiostylis,* and particularly of *Humirianthera* and *Icacina.*

Enlargement of the vessels in the first-formed secondary xylem, *Fig. 10,* coupled with conspicuous "anomalous" types of structure, occurs characteristically in the Iodeae, Sarcostigmateae, and Phytocreneae and has been adequately illustrated in the first paper of this series. *Mappianthus* and *Sarcostigma* are exceptional in having a normal cylindrical secondary body and vessels that are not aggregated between the orthostiches. *Sarcostigma* is characterized, in addition, by having numerous strands of intraxylary soft bast and vessels that are arranged in loose radial groupings. Furthermore, we have called attention in our preceding paper to the fact that in *Hosiea sinense* (Oliv.) Hemsl. and *Iodes liberica* Stapf, the young stems are extraordinarily variable; certain of them having small vessels that are localized in distribution and others having large vessels that are more or less uniformly arranged around the stem.

In most of the Iodeae, Sarcostigmateae and Phytocreneae, the pitted vessels of the metaxylem have exclusively porous perforations. There commonly is a higher ratio of vessel members with slightly inclined or transversely oriented perforate facets in both the metaxylem and secondary xylem, *Fig. 49,* of these plants than there is in a majority of the unilacunar Icacineae. The most highly specialized vessels of the Icacinoideae occur in various representatives of the Phytocreneae. The larger vessels frequently are composed of very short members which are broader than long, have truncated ends and are devoid of projecting tips, *Fig. 48.* These plants also form curious slender, "fibriform" vessel members in the much modified outer part of the primary body.

DISCUSSION

The data recorded in the preceding pages indicate that there are clearly defined trends of specialization in the vessels of the Icacinoideae. Most of these lines of phylogenetic modification are irreversible and parallel those that occur in other families of the dicotyledons. Thus, it is possible to differentiate the Icacinoideae into various levels of

increasing structural specialization. That such levels of specialization may be of some taxonomic, as well as of purely phylogenetic, interest is suggested not only by the general grouping of genera and tribes within our three major categories of the Icacinoideae, but also by the fact that all of the Icacineae in Group III have unilacunar nodes whereas those in Group I and II have trilacunar ones. It should not be inferred from this, however, that all of the genera in one of these categories are necessarily more closely related genetically to one another than to genera in the other categories. Parallel development and convergent evolution are of such common occurrence in foliar and cauline, as well as in floral, structures that evidence from all parts of the plant must be harmonized and integrated in attempting to determine actual genetic affinities within an order, family, sub-family or tribe. Therefore, a discussion of the taxonomic implications of the data presented in this paper should be deferred until we have completed our investigations of other tissues and organs of the Icacinoideae.

SUMMARY

1. A study of the vessels reveals salient irreversible trends of structural specialization in the Icacinaceae which parallel those that occur in other families of the dicotyledons.

2. These lines of phylogenetic specialization tend in general to be more or less closely correlated and may be utilized in differentiating the Icacinoideae into successive levels of increasing structural modification.

3. For the present, it is not advisable to attempt to subdivide the Icacinoideae upon this basis into more than three major categories: (I) those having vessels with exclusively scalariform perforations, (II) those having scalariform-porous perforations in the vessels of the secondary xylem and (III) those having exclusively porous perforations in the secondary body.

4. It is significant in this connection that the unilacunar Icacineae — which were differentiated in the first paper of this series — occur together with the unilacunar Iodeae, Sarcostigmateae and Phytocreneae in our third category of the Icacinoideae.

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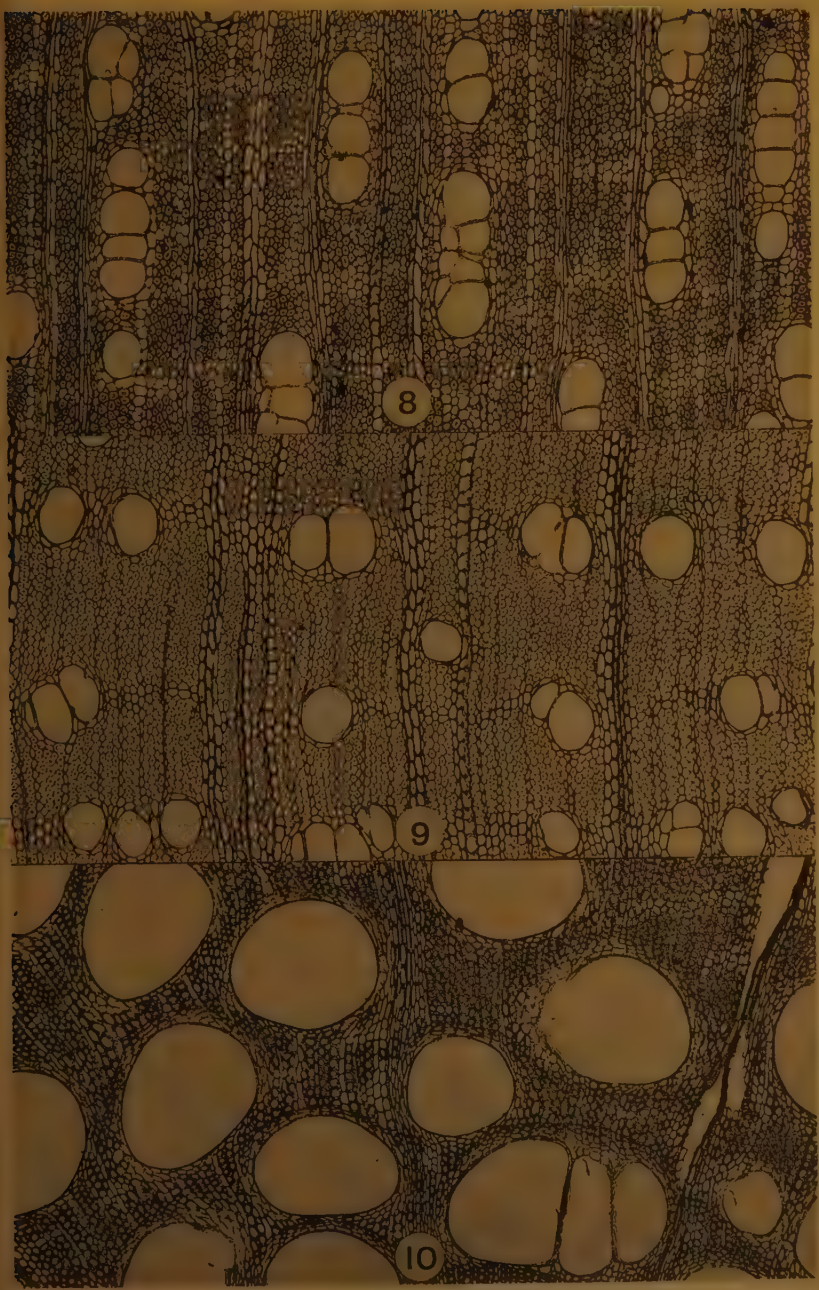
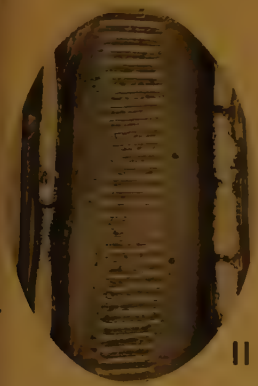
Comparative Morphology of the Icacinaceae

Comparative Morphology of the Icacinaceae

FULL-TONE—MERIDEN



Comparative Morphology of the Icacinaceae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Comparative Morphology of the Icacinaceae

FULL-TONE — MERIDEN


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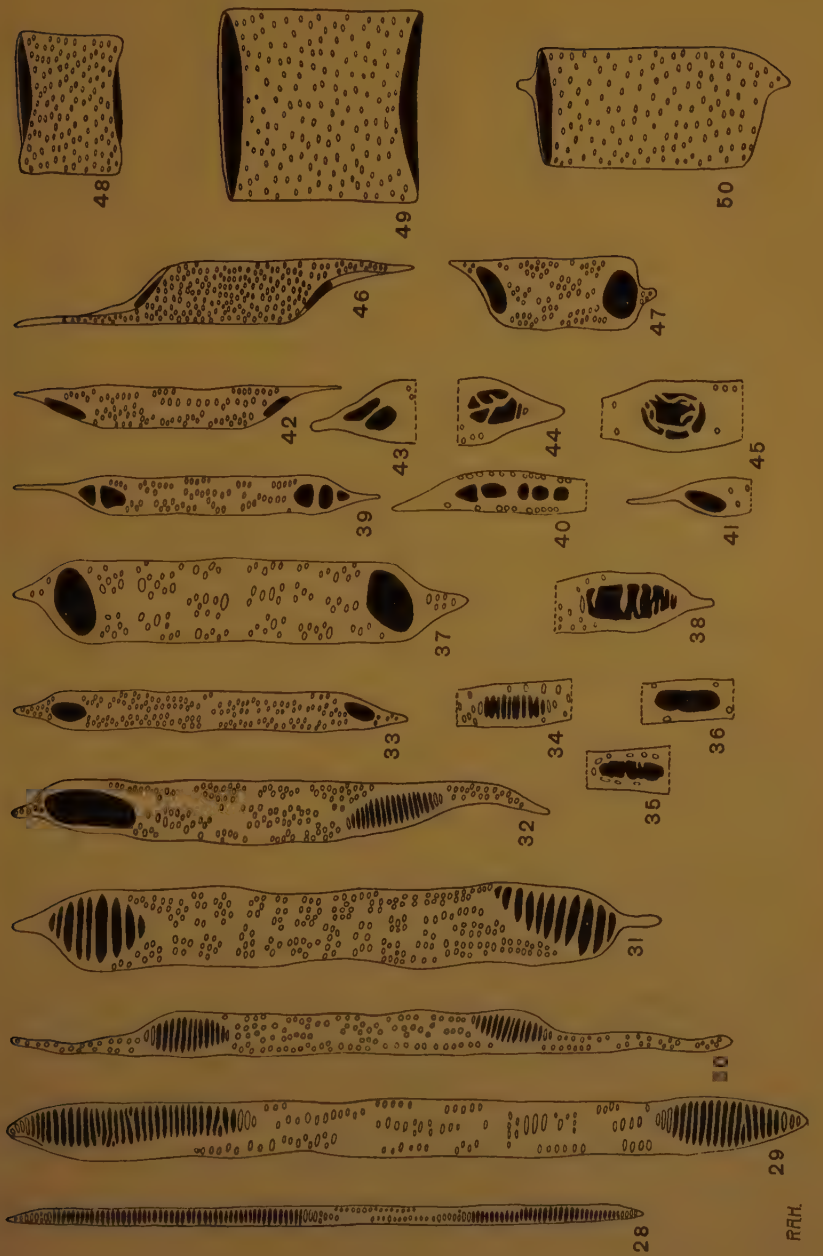
Comparative Morphology of the Icacinaceae



Comparative Morphology of the Icacinaceae

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DESCRIPTION OF PLATES

Plate I

Group I

Fig. 1. *Oecopetalum guatemalense* Howard, *Skutch 954.*
Transverse section of the secondary xylem. × 50.

Fig. 2. *Citronella Smythii* (F. v. Muell.) Howard, *Y. U. 20056.*
Transverse section of the secondary xylem. × 50.

Fig. 3. *Apodytes javanica* K. & V., *Y. U. 30521.*
Transverse section of the secondary xylem. × 50.

Plate II

Group II

Fig. 4. *Cantleya corniculata* (Becc.) Howard, *Y. U. 12586.*
Transverse section of the outer secondary xylem. × 50.

Fig. 5. *Cantleya corniculata* (Becc.) Howard, *Kew 2797.*
Transverse section of the inner secondary xylem. × 50.

Fig. 6. *Stemonurus luzoniensis* (Merr.) Howard, *Y. U. 2310.*
Transverse section of the secondary xylem. × 50.

Fig. 7. *Urandra secundiflora* (Blume) O. Ktze., *Y. U. 16041.*
Transverse section of the secondary xylem. × 50.

Plate III

Group III

Fig. 8. *Mappia racemosa* Jacq., *Y. U. 12196.*
Transverse section of the secondary xylem. × 50.

Fig. 9. *Desmostachys Vogelii* Stapf, *Y. U. 15097.*
Transverse section of the secondary xylem. × 50.

Fig. 10. *Iodes ovalis* Bl., *H. U. 2775.*
Transverse section of the secondary xylem. × 50.

Plate IV

Group I

Fig. 11. *Platea species*, *Y. U. 20201.*
Scalariform intervascular pitting. × 230.

FIG. 12. *Platea parviflora* K. & V., *Y. U. 30529.*
Scalariform and opposite intervascular pitting. × 230.

FIG. 13. *Citronella Smythii* (F. v. Muell.) Howard, *Y. U. 20056.*
Widely spaced opposite intervascular pitting. × 230.

Group II

FIG. 14. *Urandra Ammui* Kanehira, *Y. U. 20405.*
Large scalariform and transitional intervascular pits. × 230.

FIG. 15. *Discophora guianensis* Miers, *N. Y. 87444.*
Vessel of first-formed secondary xylem showing opposite and alternate intervascular pitting. × 230.

FIG. 16. *Stemonurus Merrittii* Merr., *H. U. 8215.*
Helically arranged opposite intervascular pitting, transitional to alternate. × 230.

Group III

FIG. 17. *Alsodeiopsis Staudtii* Engl., *Y. U. 24019.*
Alternate intervascular pitting. × 230.

FIG. 18. *Mappia racemosa* Jacq., *Y. U. 12196.*
Alternate intervascular pitting. × 230.

FIG. 19. *Miquelia caudata* King, *N. Y. 4478.*
Alternate intervascular pitting. × 230.

PLATE V

Group I

FIG. 20. *Platea latifolia* Bl., *Y. U. 30522.*
Scalariform vessel-parenchyma pitting. × 450.

FIG. 21. *Poraqueiba sericea* Tul., *Y. U. 17781.*
Scalariform vessel-parenchyma pitting with enlarged apertures. × 450.

FIG. 22. *Anisomallon clusiaefolium* Baill., *Y. U. 14252.*
Scalariform and opposite vessel-parenchyma pitting. × 450.

FIG. 23. *Dendrobangia boliviana* Rusby, *N. Y. 2856.*
Scalariform and reticulate perforations. Scalariform and opposite intervascular pitting. × 230.

FIG. 24. *Citronella Smythii* (F. v. Muell.) Howard, *Y. U. 20056.*
Opposite vessel-parenchyma pitting. × 450.

Group II

FIG. 25. *Stemonurus luzoniensis* (Merr.) Howard, *Y. U. 2310.*
Opposite vessel-parenchyma pitting. × 450.

FIG. 26. *Discophora guianensis* Miers, *Y. U. 34081.*
Large alternate vessel-parenchyma pitting. × 450.

FIG. 27. *Gonocaryum cognatum* Elmer, *H. U. 22242.*
Alternate vessel-parenchyma pitting. × 450.

PLATE VI

Group I

FIG. 28. *Platea excelsa* Bl., *H. U. 2766.*
Vessel from the first-formed secondary xylem. × 55.

FIG. 29. *Platea species*, *Y. U. 20201.*
Vessel from the outer secondary xylem. × 55.

FIG 30. *Apodytes dimidiata* E. Mey., *Y. U. 14933.*
Vessel from the outer secondary xylem. × 55.

FIG. 31. *Emmotum holosericeum* Ducke, *Y. U. 33816.*
Vessel from the outer secondary xylem. × 55.

Group II

FIG. 32. *Stemonurus luzoniensis* (Merr.) Howard, *Y. U. 2310.*
Vessel from the outer secondary xylem. × 55.

FIG. 33. *Medusanthera samoensis* (Rein.) Howard, *H. U. 19471.*
Vessel from the outer secondary xylem. × 55.

FIGS. 34–36. *Medusanthera samoensis* (Rein.) Howard, *A. 3061.*
Three types of perforations in vessels from the first-formed secondary xylem. × 220.

FIG. 37. *Urandra secundiflora* (Bl.) O. Ktze., *Y. U. 16042.*
Vessel from the outer secondary xylem. × 55.

FIG. 38. *Urandra Ammui* Kanehira. *A. 4596.*
Scalariform type of perforations in a vessel from the inner secondary xylem. × 220.

FIG. 39. *Leptaulus daphnoides* Benth., *Y. U. 19758.*
Vessel from the outer secondary xylem. × 55.

FIGS. 40–41. *Leptaulus grandifolius* Engl., *Zenker 14.*
Types of perforations in vessels from the inner secondary xylem. × 220.

FIG. 42. *Gonocaryum melanocarpum* Hochr., *Krukoff 4218.*
Vessel from the outer secondary xylem. × 55.

FIGS. 43–45. *Gonocaryum melanocarpum* Hochr., *Krukoff 4218.* Types of perforations in vessels from the inner secondary xylem. × 220.

Group III

FIG. 46. *Desmostachys Vogelii* Stapf, *Y. U. 15097.*
Vessel from the outer secondary xylem. × 55.

FIG. 47. *Mappia racemosa* Jacq., *Y. U. 12196.*
Vessel from the outer secondary xylem. × 55.

FIG. 48. *Phytocrene macrophylla* Bl., *H. U. 2770.*
Vessel from a small stem. × 55.

FIG. 49. *Iodes ovalis* Bl., *H. U. 2775.*
Vessel from a small stem. × 55.

FIG. 50. *Merrilliodendron rotense* Kanehira, *Y. U. 33233.*
Vessel from the outer secondary xylem. × 55.

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STUDIES IN THE THEACEAE, VI
THE GENUS SYMPLOCOCARPON AIRY-SHAW

CLARENCE E. KOBUSKI

IN 1936, Bullock described a new species of *Eurya*[1] from Mexico and gave it the name *Eurya Hintoni* after the collector, G. B. Hinton. The following year Airy-Shaw[2] described a new genus, *Symplococarpon,* based upon *Eurya Hintoni* Bullock and three additional Hinton specimens from Mexico, the type species being *Symplococarpon Hintoni* (Bullock) Airy-Shaw. This outstanding new genus is characterized by an inferior or nearly inferior ovary, fruit resembling that of the genus *Symplocos,* and persistent bracteoles. Its nearest relative in the Theaceae is the genus *Cleyera,* with which it agrees in "the arborescent habit, foliage, fasciculate long-pedicelled flowers, and anther structure." A detailed discussion of its generic status and relationships is so well recorded by Airy-Shaw that it would be superfluous to repeat it in this study. The following generic description contains additional information based on the more abundant material available from the Gray Herbarium, Field Museum of Natural History, Missouri Botanical Garden, New York Botanical Garden and the United States National Museum.

Symplococarpon Airy-Shaw in Hooker's Icon. Pl. **34**: t. 3342. 1937.

Trees with alternate branches. Leaves alternate, entire or serrate. Flowers hermaphroditic, axillary, fasciculate; pedicels minutely bracteate at the base with 2 persistent bracteoles, opposite or nearly so, at or near the juncture of the pedicel and the hypanthium. Sepals 5, imbricate, persistent. Petals 5, alternate with the sepals, imbricate, slightly connate at the base. Stamens 25–40, uniseriate; filaments connate at and adnate to the base of the corolla; anthers oblong-elliptic, tapering at the apex into a distinct subulate mucro. Ovary inferior, 2-celled, extreme apical portion usually exserted slightly above the base of the persistent calyx-lobes, appearing as a disk; ovules solitary in each cell; styles 2, rarely 3, free to the base, arising erect from the center of the seeming disk. Fruit indehiscent, subglobose, crowned by the persistent calyx and styles, two-celled, two-seeded.

[1]Kew Bull. Misc. Inform. **1936**: 391. 1936.
[2]Hooker's Icon. Pl. **34**: t. 3342. 1937.

TYPE SPECIES: *Symplococarpon Hintoni* (Bullock) Airy-Shaw.

KEY TO THE SPECIES

A. Apex of ovary (superior portion) hirsute.
  B. Filaments of the stamens not thickened at the base.
    C. Styles glabrous; leaf-margin entire with only an occasional vestige of denticulation; veins obscure on both surfaces. .....1. *S. Hintoni.*
    CC. Styles hirsute on lower half; leaf-margin sharply serrate; veins very prominent on both surfaces. .....6. *S. Brenesii.*
  BB. Filaments of the stamens noticeably thickened at the base.
    D. Fascicles 3–4-flowered; styles 2–3; leaves obtuse or rounded at the apex; leaf-margin entire or lightly undulate; small tree up to nine meters. .....4. *S. chiriquiense.*
    DD. Fascicles up to 11-flowered; styles 2; leaves acuminate at the apex; leaf-margin serrate; large tree up to 25 meters. .....5. *S. multiflorum.*

AA. Apex of ovary (superior portion) glabrous.
  E. Leaves lanceolate, 5–9 cm. long, 2.0–2.8 cm. wide; calyx-lobes 1.5–2.0 mm. wide; petals 2.0–3.5 mm. wide; mucro of the stamens 0.25–0.50 mm. long. .....2. *S. Airy-Shawianum.*
  EE. Leaves oblong-obovate, 8–15 cm. long, 2.5–5.5 cm. wide; calyx-lobes 3–4 mm. wide; petals 4–6 mm. wide; mucro of stamens 1.50–1.75 mm. long. .....3. *S. Purpusii.*

1. **Symplococarpon Hintoni** (Bullock) Airy-Shaw in Hooker's Icon. Pl. **34**: t. 3342. 1937, pro parte typica.

Eurya Hintoni Bullock in Kew Bull. Misc. Inform. **1936**: 391. 1936.

Small tree (*Hinton 8653,* 10 m.) with rough, glabrous, densely lenticellate branchlets. Leaves glabrous, oblong-elliptic, coriaceous, very smooth but not shining, 4–7 cm. long, ± 2 cm. wide, acute at the apex, cuneate at the base, subentire with an occasional minute denticulation on the upper half of the leaf, the midrib deeply canaliculate; petiole 1–3 mm. long. Flowers axillary, in fascicles of 1–3; pedicel ± 7 mm. long, glabrous, graceful, usually recurved. Bracteoles 2, minute, ± 1 mm. long, subopposite, sepaloid, ciliolate, otherwise glabrous. Hypanthium obconic-obovoid, glabrous, ± 2 mm. long. Calyx-lobes 5, unequal, imbricate, suborbicular, 1–2 mm. long, 1.5–2.0 mm. wide, glabrous except for the ciliolate margin. Petals 5, unequal, imbricate, 3.5–5.0 mm. long, 2.0–3.5 mm. wide, obtuse, the margin incurved. Stamens ± 30, uniseriate; filaments up to 2 mm. long, adnate to the base of the corolla; anthers less than 1 mm. long; mucro subulate, 0.25–0.50 mm.

long. The superior (disk-like) portion of the ovary sparingly hirsute. Styles 2, free, ± 3 mm. long. Fruit unknown.

MEXICO: District of Temascaltepec, State of Mexico, Mina de Agua, in a barranca, *G. B. Hinton 8653* (TYPE, Kew; isotypes, AA, FM, NY), Nov. 13, 1935 (tree 10 m.).

Recently, while engaged on some preliminary work on American Theaceae, I discovered that the species *Ternstroemia Purpusii* Brandegee belongs to *Symplococarpon.* At first, I assumed that it belonged to *S. Hintoni,* but on comparison realized that it was a new species, very distinct from the type. This species will be discussed later. It was during this comparison that I reached the conclusion that Airy-Shaw had included two entities in his *S. Hintoni.* Fortunately, the four Hinton numbers cited by Airy-Shaw are available for my examination. Of these, I find that no. *8653,* the type of *Eurya Hintoni* Bullock (now the type of *Symplococarpon Hintoni*) is distinct from the other three numbers, *2426, 3081* and *3678.* The type, no. *8653,* has narrowly elliptic, coriaceous leaves, 4–7 cm. long and ca. 2 cm. wide, entire or nearly so (slight indication of serration of a few leaves), with a canaliculate midrib. Also, the leaves are smooth and opaque, hardly shining. Because of the coriaceous texture, the veins (8–10 pairs) are quite obscure. The petals of the corolla measure 3.5–5.0 mm. long and 2.0–3.5 mm. wide. The young branchlets are densely lenticellate. The apex of the ovary above the hypanthium and calyx-lobes is sparsely hirsute. The fruit, as described by Airy-Shaw, belongs to the following species.

2. **Symplococarpon Airy-Shawianum,** sp. nov.

Symplococarpon Hintoni Airy-Shaw in Hooker's Icon. Pl. **34**: t. 3342. 1937, pro parte.

Arbor 10-metralis (procerior, fide *Hinton 3678*), ramulis glabris sparse lenticellatis. Folia lanceolata vel sublanceolata, 5–9 cm. longa et 2.0–2.8 (–3) cm. lata, basi cuneata vel rare subrotundata, apice abrupte acuminata, submembranacea, glaberrima, opaca, costa supra complanata, margine leviter serrata, nervis lateralibus ca. 14-jugis gracilibus anastomosantibus, petiolis 2–5 mm. longis. Flores axillares, 1–6 fasciculati, pedicellis basi minute bracteatis, apice infra hypanthium bi-bracteolatis, bracteolis oppositis vel suboppositis persistentibus minutissimis ca. 1 mm. longis sepaloideis ciliatis; hypanthium obconico-obovoideum, ca. 2 mm. longum, basi ca. 1 mm. et apice ca. 2 mm. diametro, glabrum, calycis lobis 5 inaequalibus imbricatis glabris ovatis vel subrotundatis pergamenaceis ca. 2 mm. longis et 1.5–2.0 mm. latis

margine ciliolatis; petala 5, ovata vel obovata, 5–7 mm. longa et 1.5–2.0 mm. lata, margine incurvata; stamina 30–40, uniseriata, filamentis glabris ad 2 mm. longis, basi petalis adnatis, antheris ca. 1 mm. longis, mucrone subulato 0.25–0.50 mm. longo; ovarium toto inferius vel fere, glabrum; styli 2, liberi, 2.5–3.5 mm. longi. Fructus (*Hinton 3678*, immaturus ?) viridis, oblongo-obovatus, ad 13 mm. longus et 7 mm. diametro, lobis calycis et stylis coronatus.

Mexico: District of Temascaltepec, State of Mexico, Manchititla, in barranca, *G. B. Hinton 3081* (type FM; isotypes, NY, US), January 2, 1933 (tree 10 m. high).—Temascaltepec, in barranca, alt. 2080 m., *G. B. Hinton 3678* (AA), March 31, 1933 (large tree; a fruiting specimen of *Hinton 2426*.)

This species is characterized by leaves 5–9 cm. long and 2.0–2.8 (–3) cm. wide, membranaceous, lanceolate-acuminate (the apex more abruptly and longer acuminate than *S. Hintoni*), denticulate, opaque, not shining, midrib (unlike *S. Hintoni*) flat. The veins are more numerous (ca. 14 pairs) and more pronounced on the lower surface than in *S. Hintoni*. The superior portion of the ovary, above the hypanthium, is strictly glabrous while in *S. Hintoni*, it is hirsute.

The fruit, probably immature, is indehiscent, oblong-obovate, up to 13 cm. long and 7 cm. diameter, brownish green, crowned by the persistent calyx-lobes and styles.

3. **Symplococarpon Purpusii** (Brandegee), comb. nov.

Ternstroemia Purpusii Brandegee in Univ. Calif. Publ. Bot. **6**: 187. 1915.

Tree (probably) with glabrous, rather smooth, sparsely lenticellate branchlets. Leaves glabrous, oblong-obovate, membranaceous, shining, 8–15 cm. long, 2.5–5.5 cm. wide, obtusely acuminate at the apex, cuneate at the base, the margin crenulate, the midrib flat, not canaliculate; petiole 2–3 mm. long. Flowers axillary, in fascicles of 1–3; pedicel ± 8 mm. long, glabrous, sturdy, usually erect, ca. 1 mm. diameter at the hypanthium. Bracteoles 2, subopposite, minute, sepaloid, ciliolate. Hypanthium obconic-obovoid, glabrous 2–3 cm. long. Calyx-lobes 5, unequal, imbricate, suborbicular, 2–3 mm. long, 3–4 mm. wide, glabrous except for the ciliolate margin. Petals 5, unequal, imbricate, 5–7 mm. long, 4–6 mm. wide, obtuse, the margin incurved. Stamens ± 30 (25–40), uniseriate; filaments 1.5–2.5 mm. long, adnate to the base of the corolla; anthers up to 2 mm. long; mucro subulate, 1.50–1.75 mm. long. The superior (disk-like) portion of the ovary glabrous. Styles 2, free, 4–5 mm. long. Fruit unknown.

MEXICO: State of Chiapas, Finca Irlanda, *C. A. Purpus 7434* (isotypes of *Ternstroemia Purpusii* AA, G, FM, NY), June 1914.

This species is based upon *Ternstroemia Purpusii* Brandegee collected by C. A. Purpus (no. *7434*) in the State of Chiapas, Mexico. It was the study of this specimen that led to the present brief survey of *Symplococarpon*.

The leaves of this species are considerably larger than those of the other two species mentioned above, 8–15 cm. long and 2.5–5.5 cm. wide, membranaceous, oblong-obovate, obtusely acuminate at the apex with a delicately serrate margin. In the leaf-margin, the flat open midrib, and the glabrous ovary, this species resembles *S. Airy-Shawianum*. The pedicels in all three Mexican species vary not more than 2 mm. in length. However, the first two are characterized by graceful recurved pedicels which measure 0.5 mm. in diameter at the base of the flower. In the plate accompanying the description of the new genus, the flowers appear to be borne on erect pedicels. The flowers in the Hinton collections studied at the Arnold Arboretum are on recurved pedicels. *Symplococarpon Purpusii* is characterized by more sturdy pedicels, varying little from those of the Hinton numbers in length, but at the point of the bracteoles the pedicels measure ± 1 mm. in diameter, as opposed to ± 0.5 mm. of *S. Hintoni* and *S. Airy-Shawianum*. This trifling difference in diameter does cause the flowers in most instances, to stand erect, especially those in the axils of the upper leaves, where they are less crowded. Some of the flowers in the lower axils do curve somewhat but not to the degree shown by those in *S. Hintoni* and *S. Airy-Shawianum*. The mucro of the stamen in this species is three-times longer (1.50–1.75 mm.) than the mucro in any other known species (up to 0.5 mm.).

4. **Symplococarpon chiriquiense,** sp. nov.

Arbor parva, 6–9-metralis (fide collectore), ramulis glabris, non lenticellatis. Folia oblongo-obovata, glabra, coriacea vel subcoriacea, 4–6 cm. longa et 1.8–3.0 cm. lata, supra nitida, subtus pallidiora, apice obtusa vel rotundata, basi cuneata, margine integerrima vel leviter undulata, costa supra complanata, nervis ca. 5–7 paribus utrinque prominentibus, petiolis glabris 2–3 mm. longis. Flores axillares, 3–4-fasciculati; pedicelli glabri, recurvi, 11–12 mm. longi, apice infra hypanthium bracteolis 2 inaequalibus 0.3–1.0 mm. longis oppositis vel suboppositis persistentibus sepaloideis ciliolatis; hypanthium glabrum, obconico-obovoideum, ca. 2 mm. longum, calycis lobis 5 inaequalibus imbricatis pergamenaceis ca. 1 mm.

longis et 1.5 mm. latis, apice obtusis vel flabelliformibus, margine ciliolatis; petala 5, obovata vel subrotundata, imbricata, 6–7 mm. longa et 4–6 mm. lata, margine incurvata; stamina ca. 25, uniseriata, filamentis glabris ad 3 mm. longis, basi subcrassis et petalis adnatis, antheris ca. 0.75 mm. longis, mucrone subulato ca. 0.3 mm. longo; ovarium fere totum inferius ovarii parte superiore dense albo-hirsuta; bi- vel ? triloculare; styli 2 vel 3, liberi, ca. 3 mm. longi, glabri. Fructus ignotus.

PANAMA: Boquete District, Chiriqui Prov., alt. 1500 m., *M. E. Davidson 799* (FM), June 27, 1938 (small tree 20–30 ft. high with cream-colored flowers.)

This species may be characterized by oblong-obovate, entire, glabrous leaves, conspicuously veined on both surfaces. The flowers are axillary and 3–4-fascicled. All parts, except the somewhat flat apex of the ovary, the very young buds and the midrib (lower surface) of the youngest leaves, are glabrous. The filaments are about 3 mm. long. The styles vary in number from two to three. This is the first instance of three styles appearing in the genus and it links *Symplococarpon* even closer to the genus *Cleyera*.

Its nearest relative is *S. multiflorum*, which can be separated from *S. chiriquiense* by the many-flowered fascicles (up to nine) as compared to the few-flowered fascicles of the present species. Also, the number of styles in *S. multiflorum* is consistently two, the leaves are serrate, and the alternate bracteoles are situated somewhat below the hypanthium. *Symplococarpon chiriquiense* and the two following Central American species differ from the Mexican species in their densely hirsute ovaries (at the apex). The ovary of *S. Hintoni* has a few scattered hairs similar in type to those of the Central American species. However, in the other two Mexican species, *S. Airy-Shawianum* and *S. Purpusii*, the ovaries are strictly glabrous.

5. **Symplococarpon multiflorum**, sp. nov.

Arbor 20–25-metralis (fide *Austin Smith A487*), ramulis ferrugineis glabris, lenticellis sparsis vel nullis. Folia oblongo-obovata vel oblongo-elliptica, glabra, coriacea, 4–7 cm. longa et 1.5–3.0 cm. lata, supra nitida, subtus pallidiora, apice acuminata, basi cuneata, margine serrata, costa supra complanata, nervis ca. 7–8 paribus utrinque prominentibus, petiolis glabris 5–7 mm. longis. Flores ad 8–11 in fasciculis axillaribus; pedicelli glabri, recurvi, 10–12 mm. longi, bracteolis 2 suboppositis minutissimis ca. 0.5 mm. longis sepaloideis inaequalibus persistentibus; hypanthium glabrum, obconico-obovoideum, 2.0–2.5 mm. longum, calycis

lobis 5 inaequalibus imbricatis pergamenaceis glabris 1–2 mm. longis et 1.7–2.0 mm. latis, apice rotundatis vel flabelliformibus, ciliolatis; petala 5, inaequalia, imbricata, subrotundata vel obovata, 5–6 mm. longa et 4–5 mm. lata, margine incurvata; stamina ca. 25, uniseriata, filamentis ca. 3 mm. longis glabris, basi manifeste crassis et petalis adnatis, antheris ca. 0.75 mm. longis, mucro subulato ca. 0.25 mm. longo; ovarium fere totum inferius, bi-loculare, ovarii parte superiore dense albo-hirsuta; styli 2, liberi, ca. 3 (–5) mm. longi, glabri. Fructus ignotus.

COSTA RICA: Palmira, region of Zarcero, alt. 1800 m., *Austin Smith A487* (TYPE, AA; isotypes, FM, MBG), Oct. 5, 1937 (tree 75 ft. high, 3 ft. at the base; bark dark brown; flowers deep salverform, cream-colored; anthers ferrugineous). — La Junta (La Chonta), *H. E. Stork 2305* (FM), May 27, 1928. — Santa Maria, alt. 1700 m., *H. E. Stork 1808* (FM), May 5, 1928 (small roadside tree with yellow flowers).

As the name indicates, this species is characterized by its many-flowered fascicles, varying from four to nine. The bracteoles, in the type, are nearly opposite and are located just below the hypanthium. In *Stork 1808* the bracteoles are alternate, nearly 2 mm. apart in some instances, with the upper bracteole as much as 2 mm. below the hypanthium. However, this character is not consistent. The filaments of the stamens are enlarged at the base. This thickened portion, which is approximately 1 mm. long, approaches the anther in size. The leaves are coriaceous and serrate.

The collector of the type states that the specimen was taken from a large tree 75 ft. high, 3 ft. at the base. *Stork 1808* is described by the collector as a small roadside tree.

6. **Symplococarpon Brenesii**, sp. nov.

Arbor parva 4–6-metralis (fide Brenes), ramulis brunneis glabris lenticellatis. Folia lanceolata, glabra, coriacea, 4.0–7.5 cm. longa et 1.5–2.75 cm. lata, supra nitida, subtus pallidiora, apice acuminata, basi cuneata, margine serrata, costa supra complanata, venis ca. 7–9 paribus utrinque prominentibus, petiolis glabris ca. 5 mm. longis. Flores axillares, 1- vel 2- (rare 3-) fasciculati; pedicelli glabri, recurvi, 10–11 mm. longi, apice bracteolis 2 suboppositis inaequalibus sepaloideis minutis 0.5–0.7 mm. longis obtusis glabris persistentibus; hypanthium glabrum, obconico-obovoideum, ca. 2 mm. longum, calycis lobis 5 inaequalibus imbricatis glabris pergamenaceis 1.0–1.5 mm. longis et ca. 1.5 mm. latis, apice obtusis vel flabelliformibus, margine ciliolatis; petala

5, inaequalia, imbricata, obtusa ca. 5 mm. longa et 4.5 mm. lata, margine incurvata; stamina uniseriata, ca. 25, filamentis glabris ad 3 mm. longis, basi petalis adnatis et non incrassatis, antheris ca. 1 mm. longis, mucrone subulato ca. 0.5 mm. longo; ovarium fere totum inferius, ovarii parte superiore dense hirsuta; styli 2, liberi, ca. 3 mm. longi, parte inferiore hirsuti. Fructus (*Brenes 6228*) obovoideus vel subglobosum, subligneus, rugosus, ca. 8 mm. longus et 6 mm. latus, calyce stylisque persistentibus coronatus, apice excepto glaber, bi-locularis, 2-spermus; semen ovoideum, brunneum, ca. 4 mm. longum et 3.5 mm. latum, intus leviter concavum, extus hemisphaericum et rugosum basi apiceque obtusum.

Costa Rica: La Palma y El Socorro de San Ramón, alt. 1175 m., *A. M. Brenes 4396* (TYPE, FM), August 27, 1925 (leaves ca. 9 cm. long and 3.5 cm. wide). — Same locality, woods and pastures, alt. 1180 m., *A. M. Brenes 4453* (FM), September 29, 1925 (tree 4–6 m. tall with spreading round crown; fruit immature). — Same locality, pastures and woods, alt. 1150 m., *A. M. Brenes 5151* (FM), November 24, 1926 (small tree with rounded crown; fruit blue, small). — Same locality, woods and pastures, alt. 1150–1175 m., *A. M. Brenes 5720* (FM), October 5, 1927 (small tree 4–5 m. tall, very branched; fruit axillary, isolated or in twos, green becoming black in drying, frequently 6–8 mm. long and 3–4 mm. diameter, surface rugose, pericarp thick, nearly woody; seeds ovoid, fleshy, light purple, 2 × 3 mm.). — Same locality, *A. M. Brenes 6228* (FM), July 24, 1928.

Symplococarpon Brenesii is characterized by glabrous, shining, coriaceous, serrate, lanceolate leaves. The flowers are somewhat smaller than those of the other Central American species and are disposed in fascicles of one or two, rarely three, flowers. The styles are hirsute along the lower half and the filaments of the stamens lack the basal thickening found to a marked degree in *S. multiflorum* and to a lesser degree in *S. chiriquiense*.

With the exception of *S. Airy-Shawianum*, this species is the only one in the genus to have been collected in fruit. All the specimens cited above, with the exception of the type, are fruiting specimens. Probably for the first time, mature or nearly mature fruit has been collected and recorded. A. M. Brenes, the collector, notes that the fruits are blue (no. *5151*). In the immature stage (no. *4453*) the fruit is oblong-obovate and probably green, with the hirsute apex and the persistent calyx-lobes clearly visible. On maturing (nos. *5151, 6228*), the two-seeded fruit appears more nearly globose, the pericarp becomes somewhat woody and thickened, and the small persistent calyx-lobes, although

still present and discernible, have become less obvious and lie appressed at the apex. It is quite difficult to decide from the mature stage whether the fruit is one-, two-, or even three-celled. However, in the immature stage (no. *4453*), the cross-sections show the fruit to be distinctly two-celled. I must confess that in my study of the mature fruit I was permitted, because of the paucity of fruit, to make very few actual sections.

This species is named after the collector, Professor A. M. Brenes, who, in the course of his collections in the San Ramón region, prepared the excellent series of specimens upon which the species has been based.

ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

MOMORDICA GROSVENORI SP. NOV. THE SOURCE OF THE CHINESE LO HAN KUO

WALTER T. SWINGLE

With two plates

IN 1932, while engaged in an agricultural survey of Kwangsi Province for the able and energetic military governor, Marshal Li Ts'ung-jen, Prof. George Weidman Groff of Lingnan University, Canton, China, discovered that the "lo han kuo," a plant widely used in household medicine in southern China, which he had been vainly seeking for many years, is cultivated in the mountains near the capital city of Kweilin by the non-Chinese Miao-tze people. Later, Prof. and Mrs. Groff visited the Kweilin region as guests of Marshal Li, who was born in this region and still maintains a residence there. On this trip visits were made to the Miao-tze villages but no living plants of the mysterious "lo han kuo" were seen. Marshal Li, however, sent a number of the swollen rootstocks to Prof. Groff at Canton, where they produced leafy shoots but no flowers, probably because of the high summer temperatures. These plants were the first of this species ever seen by botanists!

In order to learn exactly where and how the plant is cultivated, Prof. Groff requested a grant from the National Geographic Society through the late Dr. Frederick V. Coville, Chairman of the Research Committee, who with myself had been for many years anxious to find the source of "lo han" fruits and to identify the plant that produces them. Dr. Gilbert Grosvenor, President of the Society, approved the grant, and with the cooperation of Lingnan University of Canton, China, a special expedition, headed by Prof. Groff, was sent to Kweilin and vicinity in August, 1937.

The "lo han kuo" is a cucurbitaceous vine cultivated in northern Kwangsi by the Miao-tze people, who train it over horizontal trellises in special gardens cleared in the mountain forests. Abundant herbarium specimens and photographs of it were brought back by this expedition and turned over to me for identification. It became evident upon careful study of this material that it constitutes a new species of *Momordica* very distinct from any now known to botanists. I take pleasure in naming it *Momordica Grosvenori,* in honor of Dr. Gilbert Grosvenor, who for many years has encouraged liberally the geographic and botanical exploration of China.

Momordica Grosvenori sp. nov.

Ab aliis speciebus *Momordicae* differt seminibus applanatis radialiter striatis sulcatisque, margine rima lata profunde percursis, embryone ovato-lenticulari quam semine multo minore, fructus pulpa dulcissima in sicco in massam fibrosam levem coalescente, tota superficie plantae (facie superiore folii excepta) pilis minutissimis nigris ornata, folii margine sparse irregulariterque hydathodibus instructo.

A dioecious vine, climbing to 2–5 m., the roots perennial, tuberous, fusiform when young, finally subglobose, 10–15 cm. in diameter. Stems slender, the internodes 3–9 cm. long, the axillary tendrils 8–12 cm. long, bifid above the middle. Petioles slender, 2–7 (usually 3–5) cm. long, 1–2 mm. in diameter, longitudinally striate. Leaf-blades thin, ovate-cordate, sometimes hastate and nearly triangular in outline, 8–15 (rarely to 23) cm. long, 3.5–12 (rarely to 17) cm. broad, acute or acuminate at apex, deeply cordate-emarginate at base with a cuneate juncture with the petiole (see *pl. 2, fig. 1*), the margins entire, irregularly and coarsely crenulate, or shallowly lobed, very rarely with callose spathulate hydathodes projecting beyond the margins in continuation of veinlets, the lateral veins 4 or 5 pairs on each side of the midrib, the lower pair running close to the margin of the cordate sinus but soon branching into 3 or 4 strong veinlets, the 3 or 4 pairs in the upper part of the leaf-blades not showing such strong veinlets, the upper surface and margins with scattered short white or light buff hairs, the lower surface with similar hairs and also with characteristic widely scattered minute black hairlets (also found on all exposed surfaces of stems, tendrils, petioles, peduncles, pedicels, ovaries, and the outer surfaces of sepals and petals). Pistillate inflorescences clustered (2 or 3) in leaf-axils or sometimes solitary, either with simple pedicels bearing a single flower or with peduncles 3–5 cm. long bearing 2–5 flowers on pedicels 0.5–1.5 cm. long, the pedicels subtended by finely pubescent bracts 2–3 mm. long and 0.5–1 mm. broad, the bracts often caducous or lacking. Ovary inferior, oblong-ovoid, 8–10 mm. long, 3.5–4.5 mm. broad, rounded at base, 3-locular, with numerous ovules in 6 rows (see *pl. 1, fig. 2, 3, pl. 2, fig. 2*). Sepals 5, persistent, soon reflexed, 5–7 mm. long, 1.5–2 mm. broad at base, tapering into thread-like pubescent tips. Petals 5, free, thin, yellowish, lanceolate-acuminate, 20–23 mm. long and 6–7 mm. broad (in dried state), with 6 or 8 subparallel veins. Staminodes 3, slender, 2–2.5 mm. long, two of them paired, one single. Styles 3, 4–5 mm. long, 3-lobed, sometimes each lobe bifid (see *pl. 2, fig. 2*). Staminate inflorescence racemose, arising singly in leaf-axils, 9–13 cm. long, unbranched for 6–8 cm. at base, the upper portion bearing 4–15 more or less appressed pedicels 1–3 cm. long and 0.5–1 mm. in diameter, the

pedicels sometimes subtended by minute slender bracts 2–3 mm. long and 0.5–0.8 mm. broad. Staminate flowers single. Calyx funnel-shaped, 5-lobed above, the lobes 6–9 mm. long, 2.5–3.5 mm. broad at base, attenuate into slender thread-like finely pubescent tips. Petals 5, free, thin, yellowish, lanceolate-acuminate, 18–25 mm. long and 6–8 mm. broad (in dried state, possibly larger in fully developed fresh flowers), with 6 or 8 veins, two of the petals (nos. 1 and 2) bearing near the base bluntly rounded flaps (2–3 mm. long, 1.5–1.8 mm. broad, minutely pubescent above and ciliate at margins with nearly hyaline hairs, overlying those arising from the bases of the stamens). Stamens 3, two of them with a pair of anthers, the other with a single anther; filaments 3–4 mm. long (usually doubled above in the stamens with 2 anthers); anthers subtriangular, 4–5 mm. long, 2–2.5 mm. broad, extrorse, dull reddish brown on inner side, each anther with a single S-shaped pollen-locule with the outer descending arm longer (3 mm.) and the inner ascending arm shorter (2–2.5 mm.); filaments at base more or less irregularly expanded into sheets of tissue which extend under the petal-flaps and together with them almost completely cover the nectary. Fruits broadly ellipsoid, ovoid or subglobose, with broadly rounded ends, 6–11 cm. long, 3–4 cm. broad, more or less densely pubescent with yellowish (rarely reddish) hairs intermixed with numerous black hairlets, often with 6 (or more?) longitudinal stripes (see *pl. 2, fig. 6*), the peel very thin (0.5–0.8 mm. thick), the three doubled locules each with 2 rows of seeds (about 10–12 in a row) with slightly brownish gray pulp which dries to a light fibrous mass, intensely sweet in taste and with an aromatic odor and flavor (somewhat like licorice). Seeds light brownish gray, broadly oval or ovate, flattened, 15–18 mm. long, 10–12 mm. broad, 3–4 mm. thick at edges but with a depressed area (8–9 mm. long, 3–4 mm. broad) in the center of each side, surrounded by a ring of raised tissues which is radially striate and sparingly furrowed (see *pl. 2, fig. 4*), the margin deeply sunk as if eroded (see *pl. 2, fig. 4, 5*), the embryo ovate-lenticular, much smaller than the seed, 7.5–9 mm. long, 3.5–4 mm. broad, 1.8–2 mm. thick, the testa very thin, smooth (see *pl. 2, fig. 3*).

TYPE: CHINA: Kwangsi Province: Pai-shou (Po-seh) District, Niu-ho village, near Chien-kan, *Taam Ying-wah 1* (♀), 15 ft. tall, Aug. 17, 1937, cultivated in garden, 15 Chinese feet high, in Herb. National Arboretum; Dupl. Herb. Arnold Arboretum. Serial microtome sections S. and T. 508 A, slides 1–8 (longitudinal sections of half an ovary); 508 B, slides 1–12 (cross-sections of the other half of 508 A); 508 C, slides 1–20 (cross-sections of an entire ovary); 716 A, slides 1, 2, 716 B, slide 1 (cross-sections of leaves); all filed in type collection of Herb. National Arboretum.

ADDITIONAL MATERIAL: Kwangsi Province: Pai-shou District, Pao-an community near Pan-pu village, *Taam Ying-wah 69* (♂), PARATYPE, (in Herb. Nat. Arb. and Herb. Arnold Arb.). Serial microtome sections S. and T. 509 A, slides 1–7 (cross-sections of flower-bud); 509 B, slides 1–7 (longitudinal sections of flower-bud); 717 B, slide 1 (48 cross-sections of a flower-bud); 717 C, slides 1–7 (cross-sections of flower-bud); 717 D, slides 1–8 (longitudinal sections of flower-bud); 717 E, slides 1–33 (longitudinal sections of nearly mature flower); 717 A, slide 1 (cross-sections of leaf); all filed in type collection of Herb. Nat. Arb. Pai-shou District, Chih-lung village, *Taam Ying-wah 22* (♀) (in Herb. Nat. Arb. and Herb. Arnold Arb.). Boundary between Pai-shou and Kwei-lin Districts, Liu-ch'a mountains, alt. 2000 ft. (609 m.), *Groff, Hoh, & Tung 21172* (♀), Aug. 9, 1937, "Ch'ang han kuo" variety (in Herb. Nat. Arb. and Herb. Arnold Arb.). Boundary between Kweilin and Pai-shou Districts, Liu-ch'a mountains, *Groff, Hoh, & Tung 21173* (♀), Aug. 9, 1937 (in Herb. Nat. Arb.). Pai-shou District, San-wa village, near San t'ai mountain, *Taam Ying-wah 5* (♀), Aug. 18, 1937 (in Herb. Nat. Arb. and Herb. Arnold Arb.). Serial microtome sections S. and T. 729 A, slides 1–12 (cross-sections of young ovary); 729 B, slides 1–3 (cross-sections of young fruit); all filed in Herb. Nat. Arb. Clay slope near Pan-pu village of Po-an, *Taam Ying-wah 67* (♀), Aug. 27, 1937 (in Herb. Nat. Arb.), *Taam Ying-wah 71* (♀), "Ch'ang t'an tzu" variety (in Herb. Nat. Arb). Shih-lung village, *Taam Ying-wah 41* (♀), Aug. 22, 1937, "Ma ling tsu" variety (in Herb. Nat. Arb. and Herb. Arnold Arb.). Hsing-an District, Sai-on village, *T. S. Tsoong 83644* (♀), Aug. 27, 1937, young fruits red (in Herb. Arnold Arb.). Hsiang District, Yao Mountain, Ku-ch'ên, alt. about 5000 ft. (1570 m.), *Huang Chi 40248,* seen by Prof. Groff and Hoh Hin-cheung, marked "lo-han-kuo," with green fruits only (in Herb. Sun Yatsen Univ. no. 97307).

Kiangsi Province: Chung-jên District, near Li-pei-chiao, alt. 200–700 m., *Y. Tsiang 10200* (♀), July 7, 1932 (in Herb. N. Y. Bot. Gard.).

Kwangtung Province: Hainan Island, Chang-kiang District, O-kao (Ngo-ko) Mt., near Chin-ch'i (Tsat cha) village, *S. K. Lau 1925* (♂), June 12, 1933 (in Herb. Arnold Arb., Gray Herb., and Herb. Nat. Arb.). Hainan Island, Kan-ên (Kum-yun) District, *S. K. Lau 27685* (♂), Aug. 18, 1936; "fruit scarlet" (on ♀ plants) (in Herb. Arnold Arb.). Serial microtome sections S. and T. 721 A, slide 1 (cross-sections of leaf); 721 B, slides 1–7 (cross-sections of flower-buds); 721 C, slides 1–4 (longitudinal sections of flower-buds); all filed in Herb. Nat. Arb.

The two collections of wild plants growing in Hainan Island were studied by Dr. E. D. Merrill, Director of the Arnold Arboretum, and by Dr. Franklin P. Metcalf, Botanist of Lingnan University at Canton, China, and were found by them to represent a new species of cucurbitaceous plant native in China. When it became obvious that these Hainan plants belonged to the same species as the one cultivated in Kwangsi province, the dried material, notes, and drawings of the Hainan material were turned over to me so the species could be based on the more abundant collections of both male and female plants. I wish to take this occasion to render thanks for this most generous action.

As appears from the above enumeration of the known material, *Momordica Grosvenori* is known from three rather widely separated regions in southwestern China: (1) the mountains westward from Kweilin in the northeastern part of the province of Kwangsi, where it is intensively cultivated in several districts at altitudes of 600 meters and over (found growing wild at 1570 meters); (2) about 600–700 kilometers northeast of Kweilin in the north-central portion of Kiangsi Province in Chung-jên district southwest of Yang-po lake, at altitudes of 300–700 meters; (3) about 700 kilometers south of Kweilin in two districts of Hainan Island at altitudes of 610 meters or over. In Kwangsi province it grows in the mountains in shady forests where *Cunninghamia lanceolata,* the tea-oil tree, *Thea sasanqua,* and the wood-oil tree *Aleurites Fordii* are native. In these foothill mountain forests, rains and fogs are frequent in the summer season. "Lo han kuo" tubers transplanted by Groff from Kweilin to Canton near sea level gave rise to vigorous vines but did not flower.

Four principal varieties of the "lo han kuo" are grown in the Miao-tze country, where they are propagated by dividing the tuberous roots. These varieties show rather striking differences in the shape and color of the fruit and in the shape and size of the leaves, and also in the degree of evenness of the leaf-margins. In some varieties a very few hydathodes can sometimes be detected along the leaf margins, but more often they are wanting entirely. Nothing is known as to the fruit characters of the wild plants of *Momordica Grosvenori.* The leaves of the Kiangsi province plant (*Y. Tsiang 10200*) are the largest known, reaching 23 cm. in length and 13 cm. in width. Those of the Hainan Island plant (*S. K. Lau 1925*) are the smallest, 6.5–8 by 3.5–5 cm. Male plants are not cultivated by the Miao-tze people and for this reason are seldom seen. Flowers collected from the wild plants growing in the mountains are used by the Miao-tze people to pollinate the cultivated female plants.

Momordica Grosvenori, in common with a number of other species of *Momordica,* has the double nectary protection by two basal petal flaps

supplemented by broad proliferations from the bases of the 3 stamens, very similar to that described and figured in *M. trifoliata* by A. Zimmermann (Die Cucurbitaceen **2**: 61–62. *fig. 44, 45.* 1922). Several other species of *Momordica* studied in minute detail in East Africa by Zimmermann show striking homologies with *M. Grosvenori* in the morphology of the male flowers.

A species of *Momordica* native to northern French Indochina, *M. tonkinensis* Gagnep. (in Bull. Mus. Hist. Nat. Paris **24**: 376. 1918; figured in Flore gén. de l'Indo-Chine **2**: 1070. *fig. 120* [*5–8*]. 1921), presents certain analogies to the "lo han kuo," and may prove to be a somewhat related species. The general appearance of this plant is evidently much like that of *M. Grosvenori* and its leaves are said to be "atro-glandulosa" on the under side, but it is not stated whether this is due to the presence of scattered black hairs as in the "lo han kuo." The fruits are unknown and the male inflorescences differ from those of the "lo han kuo" in having a very short corymb containing 12–15 flowers borne at the end of a peduncle 9–11 cm. long. It is described as having five free stamens. The male flowers have broad and rather bluntly pointed sepals very different from those of *M. Grosvenori,* which has the sepals long-acuminate, ending in slender thread-like tips.

The "lo han kuo" is a small gourd-like fruit having an intensely sweet taste, widely used by the South Chinese as a household remedy for colds, sore-throat, and minor stomach and intestinal troubles. From the studies of Prof. Groff and his Chinese assistants, it appears that about 1000 tons of the green fruits are delivered every year to the drying sheds at Kweilin. The fruits lose much weight in drying and are then packed in boxes and shipped to Canton where most of the crop is consumed, but large numbers of the "lo han" fruits are exported to the Cantonese living in the United States and other over-sea countries.

Professor Groff was able to secure seeds of the "lo han kuo" near Kweilin in 1937 and found they retained their viability for a long time. Some of the seeds were planted at Lingnan University, Canton, China. The young seedlings soon developed fusiform roots. Half a dozen of these roots were recently presented to the Division of Plant Exploration and Introduction of the Bureau of Plant Industry by Professor Groff[1] through the National Geographic Society. It is hoped that these plants

[1]I wish to render here grateful acknowledgment to Professor G. Weidman Groff, not only for these living plants, but also for all of the details mentioned in this paper regarding the culture and curing of the "lo han kuo," which were taken from a manuscript report by Groff and Hoh on their trip to northern Kiangsi made in 1937. This report was put in my hands by Dr. Gilbert Grosvenor, President of the National Geographic Society, in order to aid me in determining the taxonomic status of this plant.

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Momordica Grosvenori Swingle

Momordica Grosvenori Swingle

FULL-TONE — MERIDEN

represent both sexes and that cuttings from them may be tested at different altitudes and different climates in hope of finding localities in the United States where this remarkable plant can be grown successfully. This will permit much better material than that now available to be obtained for use in determining its relationships in the genus *Momordica*.

EXPLANATION OF PLATES

Plate 1

Momordica Grosvenori Swingle. Female plants: Fig. 1, *Taam 22;* Fig. 2, 3, type, *Taam 1.* Male plant: Fig. 4, 5, 6, paratype, *Taam 69.*

Fig. 1. Flowering twig. × ½.

Fig. 2, 3. Serial microtome cross-sections of ovary, showing 3 locules, each with 2 rows of ovules, also both pale yellow and black hairs covering the outer wall. × 6.

Fig. 4. Flowering twig, showing slender racemose ♂ inflorescences. × ½.

Fig. 5. Longitudinal microtome section of ♂ flower-bud, showing petal flap (right) and growth starting to form at base of filament (left). × 6.

Fig. 6. Longitudinal microtome section of nearly mature ♂ flower showing (to right) petal flap which overlaps the proliferation at base of the staminal filament growing over the nectary, also 2 S-shaped pollen-locules of 2 anthers. × 3.

Plate 2

Momordica Grosvenori Swingle. Female plants: Fig. 1, 2, *Taam 22;* Fig. 3, seed from a fruit purchased in a Chinese shop in San Francisco; Fig. 4, 5, *Taam 71, Ch'ang t'an tzu* variety, from Jose Gomez' drawing No. 17; Fig. 6, three cured fruits of the *Ch'ang t'an tzu* variety, Groff photograph No. 1206.

Fig. 1. Flowering branch, showing ♀ inflorescences with flower-buds and flowers, from Jose Gomez' drawing No. 9. × ½.

Fig. 2. Longitudinal microtome section of young ovary showing numerous ovules, 3-parted style, and abundant small pale yellow and black hairs covering outer wall, microtome section. × 10.

Fig. 3. Cross-section of mature seed showing the outline of the small embryo and the collapsed tissues of the erose margin. × 6.

Fig. 4. Mature seed showing radial striae and furrows, also depressed area over the embryo in the center. × 2.

Fig. 5. Side view of seed showing erose margin. × 2.

Fig. 6. Cured and polished fruits of *Ch'ang t'an tzu* variety. × ½.

Bureau of Plant Industry,
U. S. Department of Agriculture,
Washington, D. C.

NEW SPECIES OF MALLOTUS

FRANKLIN P. METCALF*

IN this paper four new species and one new variety are proposed, and in addition one new combination is made. In the group with densely tomentose stems and capsules a key is added to distinguish the closely related species.

The writer wishes to thank Dr. E. D. Merrill, Director of the Arnold Arboretum, for facilities made available during the progress of this work, and Dr. Leon Croizat, specialist in the Euphorbiaceae, for his friendly criticism of the manuscript.

1. **Mallotus apelta** (Lour.) Müll.-Arg. var. **kwangsiensis** Metcalf var. nov.

Mallotus sp. in discussion under *Mallotus Stewardii* Metcalf in Lingnan Sci. Jour. **10**: 489. 1931.

Mallotus apelta Croizat in Jour. Arnold Arb. **19**: 142–3. 1938, *quoad spec. cit. e* Kwangsi, *Ching 7111, non* Müll.-Arg.

A typo speciei differt aculeis capsulae multo longioribus flavidis nec albis.

Capsular spines much longer than in the species, giving a looser, less compact appearance to the ♂ inflorescences, and yellowish in color rather than pearl-white. The peduncle of the ♂ inflorescence is also unusually long, up to 16 cm. As Croizat (l. c.) has pointed out, it resembles somewhat the Bornean and Javanese material of *Mallotus ricinoides* Müll-Arg.

KWANGSI: Yeo Mar Shan, N. Hin Yen, 4000 ft., *R. C. Ching 7111*, TYPE, Aug. 24, 1928, in open wood, tree, 25 ft.

Fan & Li 4, from Chang Ning Hsien, Hunan, may also belong here, but is not an exact match. Possibly it may represent a form of *Mallotus Paxii* Pamp. Further field work will be necessary before the relationships of this specimen from Hunan can be established. New collections from Kwangsi, Hunan and Tonkin may help greatly to clarify the limits within this group.

2. **Mallotus Croizatianus** Metcalf sp. nov.

Arbor usque ad 7 m. alta; ramulis villoso-tomentosis, ultimis 7–10 mm. diametro; foliis alternis, peltatis, palmatinerviis, chartaceis, late

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ovatis vel subrotundatis, 20–40 cm. longis et 20 cm. latis, elobatis vel 1–3-lobatis, lobis lateralibus breviter triangulari-acuminatis, lobis terminalibus gradatim acuminatis vel caudato-acuminatis, basi rotundatis, supra subglabris, subtus tomentosis, nervis 7–9; petiolo variabili, in foliis superioribus 2–5 cm. longo, in foliis inferioribus maturis ad 20 cm. longo, dense villoso-tomentoso; ♂ inflorescentiis paniculatis; ♀ inflorescentiis, racemosis congestis, dense tomentosis; floribus ♂ : sepalis ellipticis, 3.5 mm. longis et 2 mm. latis, dense stellato-tomentosis; staminibus multis, plus quam 120; ♀ floribus: sepalis 4, lanceolatis, acuminatis, 4–4.5 mm. longis, dense stellato-tomentosis; stylis 3, exsertis, recurvatis, stigmatibus piloso-subfimbriatis; fructibus globosis, ad 2 cm. diametro, aculeis dense stellato-tomentosis apice glabris, brunneis; pedicello stellato-tomentoso, 2–4 mm. longo.

KWANGSI: En route Liang-chiang to Pai-shan city, Pai-shan district, *Y. W. Taam 4,* TYPE ♀, Aug. 17–18, 1937, abundant among shrubs on dry, rocky, sandy soil of Chien-kan-shan, near Niu-lo ts'un, erect woody plant, 2 m. high with fragrant, yellow flowers, "P'ao-mu-shu." Shap Man Taai Shan, near Ping Hoh village, S.E. of Shang-sze, Kwangtung border, Shang-sze district, *W. T. Tsang 22132,* ♂, April 17, 1922, abundant in meadow along roadside or in dry clay, woody, 4 ft., fl. yellow. Na Hung, Ling Yün Hsien, *A. N. Steward & H. C. Cheo 356,* May 7, 1933, ♂, shrub, 7 m. with yellow flowers; specimen also with portion of bark, ex Herb. Univ. Nanking.

3. **Mallotus Dunnii** Metcalf sp. nov.

Mallotus Roxburghianus Müll.-Arg. var. *glabra* Dunn in Jour. Linn. Soc. Bot. **38**: 365. 1908; Pax & Hoffmann, Pflanzenr. (Heft. 63) IV. **147.** VII: 173. 1904 *in nota* (as var. *glaber* Dunn); Croizat in Jour. Arnold Arb. **19**: 144. 1938.

FUKIEN: Yenping, Buong-kang Village, *Dunn 1136-HH 3437* (HK, K, AA.)

This material is so distinct that it should not be retained as a variety. Furthermore, the specimen cited above does not have the pubescence characteristic of *Mallotus Roxburghianus* Müll.-Arg. The leaves are small, peltate, palmately 8–10-nerved, subrotund, with 1–3 lobes at the apex, glabrous on both sides with the base of the leaf rotund and the lobes acuminate; the blades are approximately 18 cm. long and 15 cm. wide; the petioles are 8–15 cm. long; the inflorescence is terminal, racemose, with slender pedicels (0.5–3.5 cm. long), with the lowest pedicels distinctly the longest.

The specimen seen by Croizat and myself in the herbarium of the Arnold Arboretum is sterile. The description of the inflorescence is

based on my notes taken in the herbaria of Kew and of the Hongkong Botanical Garden.

4. **Mallotus lotingensis** Metcalf sp. nov.

Mallotus barbatus (Wall.) Müll.-Arg. var. *congestus* [*congesta*] Metcalf in Lingnan Sci. Jour. **10**: 487. 1931.

KWANGTUNG: On way to San Kai Tin, Loting, *Ying Tsiang 1131*, Sept. 13, 1928. Sunyi, *Ying Tsiang 2734*, June 17, 1929, in open, along water, shrub. (Both formerly distributed as *M. barbatus* Müll.-Arg.). *Squire 317* from Hue, Indo-China, a ♂ specimen, probably also represents this species.

Croizat (in Jour. Arnold Arb. **19**: 135. 1938), in his discussion under *M. barbatus* var. *pedicellaris* Croizat, has suggested that *M. barbatus* var. *congestus* Metcalf is a form that has sessile or subsessile fruit on a congested inflorescence, and that it is doubtfully conspecific with his new variety, adding that "it is probable that a better knowledge based on more ample collections of Chinese *M. barbatus* will introduce further changes in the treatment and limits of the species."

After making an additional study of this material along with some new material not available in 1930–31, I have come to the conclusion that this is in reality a good species and not a variety. It is much nearer in its relationships to *M. luchenensis* Metcalf from Kwangsi, Hunan, and Kwangtung, than to *M. barbatus* from Yunnan, Szechuan, Annam, and Cochinchina. The leaves, young branches, petioles and inflorescences are densely stellate and soft velvety-tomentose beneath. The ♀ inflorescence is a congested eglandular raceme, and the capsules are sessile, stellate-pubescent, with the spines quite noticeable.

5. **Mallotus luchenensis** Metcalf sp. nov.

Arbor vel suffrutex usque ad 3 m. altus; ramis farinoso-tomentosis, ramulis villosis, dense tomentosis, flavis vel flavo-ferrugineis; foliis late ovatis vel subrotundatis, 15–30 cm. longis, 10–15 cm. latis, 3-lobatis, lobis rare nullis vel uno laterali, lobo terminali triangulari-acuto vel acuminato, lobis lateralibus acutis vel caudato-acuminatis, basi cordatis vel rotundatis vel truncatis, supra, nervis exceptis, subglabris, subtus dense stellato-tomentosis, pilis in foliis maturis albis, in foliis juvenilibus ferrugineis; petiolo usque ad 10 cm. longo, dense tomentoso-pubescente; inflorescentiis terminalibus, elongato-racemosis, ad 30 cm. longis, dense stellato-tomentosis; ♂ inflorescentiis: sepalis ellipticis, stellato-tomentosis; staminibus numerosis; ♀ inflorescentiis elongato-racemosis; sepalis ovatis, stellato-tomentosis; stylis 4, recurvis exsertis: stigmatibus papilloso-fimbriatis; fructibus subglobosis, leviter denseque stellato-

tomentosis, 10 mm. longis latisque; pedicello 6–10 mm. longo, dense tomentoso; calyce et stylis persistentibus; aculeis totis massam unam efformantibus, brunneo-nigris, minute glandulosis, pilis confertis stellato-tomentosis undique indutis.

KWANGSI: Shan Fang, N. Luchen, 1500 ft., *R. C. Ching 5699,* June 6, 1928, TYPE ♀, in open thicket, spreading shrub, 10 ft., with gray bark. KWANGTUNG: Ting Wu Shan, *W. Y. Chun 6342* ♂ and *6400* ♀ (2 sheets), May 5 and 6, 1928, in open shrub, or light woods; tree 2.5–3 m. high. KWEICHOW: Ad viam Tschenning Huangtsaubam fluminis Houdjiau ho in silva lateris australis, *Handel-Mazzetti 10364,* June 20, 1917; Tuyun, *Y. Tsiang 5766,* July 12, 1930, in dense shade, tree 6 m. high, diam. breast high, 15 cm., sterile specimen.

INDO-CHINA: Tonkin, prov. Santay, *Petelot 2218,* ♀, June, 1939, tree 7–8 m.

This species was formerly confused with *Mallotus barbatus* Müll.-Arg. and its variety *congestus* Metcalf (= *M. lotingensis* Metcalf). It is, however, probably more closely related to *M. lotingensis* from Kwangtung than it is to either the species *M. barbatus* or its variety *pedicellaris* Croizat. This species has leaves similar to *M. barbatus,* but the fruits are short- rather than long-pedicelled, and the capsules are reddish or reddish orange, not yellowish or straw-colored. From *M. lotingensis* it can be distinguished by the pedicelled, not sessile, capsules in loose, not congested, racemes.

6. **Mallotus philippensis** (Lam.) Müll.-Arg. var **reticulatus** (Dunn) Metcalf comb. nov.

Mallotus reticulatus Dunn in Jour. Linn. Soc. **38**: 365. 1908.

Pax & Hoffmann, in Pflanzenr. (Heft. 63) IV. **147**. VII: 184. 1914, have listed *Mallotus reticulatus* Dunn as a synonym of *M. philippensis* Müll.-Arg. *Mallotus reticulatus,* in my opinion, is not typical *M. philippensis* Müll.-Arg. On the other hand, it should not be treated as a distinct species. If *Dunn 3429* from unexplored western Fukien were the only collection available to me, I might still consider it a good species, but another specimen collected by Ford in Hongkong shows a dentation which is not quite so pronounced. Both specimens, nevertheless, are characterized by coarsely dentate leaves, hardly serrate, as stated by Dunn (l. c.). *Dunn 3429* has more deeply dentate leaves, which are coriaceous, distinctly and finely reticulate, and with a very peculiar yellowish bloom in addition to the usual red granular glands and pubescence beneath. The specimen is also much more densely pubescent.

The yellowish bloom and prominent reticulate lower surface of the leaves are the most distinctive characteristics.

WESTERN FUKIEN: Wong Ka Chi, *Dunn 164-HH 3429*, TYPE of *M. reticulatus* Dunn (HK, AA). KWANGTUNG: Lung-tau-shan, *LU 12890* (*To & Tsang*) (CCC; fragment, AA). HONGKONG: *Ford* (AA).

One sheet from Futschau (Foochow) collected in 1887, namely *Warburg 5876*, has leaves with a somewhat dentate margin, but these leaves are subcoriaceous, much thinner than those of the typical variety, and lacking the yellowish bloom and the somewhat distinct raised reticulations; hence is placed here with doubt.

Below I am adding a key to characterize and distinguish the species in the "*barbatus*" group, namely *M. barbatus* Müll.-Arg., *M. barbatus* var. *pedicellaris* Croizant, *M. luchenensis* Metcalf, *M. lotingensis* Metcalf, and *M. Croizatianus* Metcalf.

KEY TO THE "BARBATUS" GROUP OF MALLOTUS

a. Spines of capsule forming a continuous stratum.
  b. Capsules yellowish.
    c. Pedicels short, 1 cm. or less, mostly less; capsules about 12 mm. diam.; branchlets shaggy-tomentose (Yunnan, Szechuan). ..... *barbatus* Müll.-Arg.
    cc. Pedicels longer, 1–4.5 cm.; capsules 15–16 mm. diam.; branchlets tomentose (Szechuan). . . *barbatus* var. *pedicellaris* Croizat
  bb. Capsules reddish or reddish orange; branchlets rather shaggy-tomentose (Kwangsi, Kwangtung, Tonkin)...*luchenensis Metcalf*
aa. Spines of capsule not forming a distinct stratum but appearing somewhat echinate.
  b. Capsules about 1 cm. diam. and somewhat congested or confluent in the spike; branchlets shaggy-tomentose (Kwangtung and Annam). ..... *lotingensis* Metcalf
  bb. Capsules about 2 cm. diam., scattered, not congested or confluent; branchlets shaggy-tomentose (Kwangsi). . . *Croizatianus* Metcalf

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RELCHELA PANICOIDES STEUDEL GRAMINEAE ENDEMICA EN CHILE[1]

Carlos Muñoz[2]

Con una lámina

Durante las observaciones sobre algunos géneros de Gramineae representados en Chile, Dr. Agnes Chase nos llamó la atención sobre las características peculiares de *Relchela panicoides* Steudel, haciéndonos ver las posibilidades de reconocer este género mono-específico en su verdadero valor taxonómico y filogénico. La abundancia de material crítico encontrado en el Herbario de Gramíneas del Museo Nacional de los EE.UU. nos indujo a efectuar un estudio sobre el mencionado tema.

Relchela Steudel (20) es un anagrama creado por el autor a base de Lechler, colector de la especie. *Lechlera,* nombre inédito, solo ha sido mencionado por Steudel en correspondencia a botánicos y amigos suyos.

Desde la época de su creación (1854) el género ha sido mal interpretado. Su única especie, *Relchela panicoides* Steudel, descrita en Paniceae, ha sido incluída en el género *Calamagrostis* y sus sinónimos descritos en *Panicum* y *Agrostis.*

Bentham (2: 91) la incluye por primera vez en *Deyeuxia* Clarion (*Lachnagrostis* Trinius), comentando que "*Relchela,* Steud., . . . *Cinnastrum,* Fourn. (at least as to *Deyeuxia poaeformis,* Kunth.), *Deyeuxia mutica,* Wedd., and *D. breviglumis,* Benth., with a few other South-American species, form a little group with a glabrous rhachilla and the awn reduced to a small point." Al mismo tiempo indica *Agrostis sesquivalvis* Desv. (error para *A. sesquiflora* del mismo autor) como sinónimo.

Bentham & Hooker (3: 1153) la menciona como *Deyeuxia,* hoy dia considerada sub-sección de *Calamagrostis,* indicando una vez más *Agrostis sesquiflora* como sinónimo.

Hackel (11) la sigue considerando *Calamagrostis* (§ *Deyeuxia*), haciendo notar su anomalía dentro de ella. *Index Kewensis* (15) la anota también bajo *Deyeuxia,* y Dalla Torre & Harms (9) la coloca bajo *Calamagrostis* Adans. Bews (4) adopta la misma opinión de Hackel.

[1]Leído ante la sección respectiva del Congreso Científico Americano, el 17 de Mayo de 1940, en Washington, DC.

[2]Manuscrito realizado bajo el auspicio de John Simon Guggenheim Memorial Foundation, durante la renovación de la beca latino-americana para Chile, con que fué agraciado durante 1939–40.

Ultimamente Pilger (19) crea una nueva sección del género *Briza* (§ *Relchela*), basando su nueva combinación específica en *Agrostis sesquiflora* Desv., atendiendo seguramente a la opinión de los autores anteriormente citados.

Estos antecedentes fundamentados en consideraciones a priori, sin la consulta previa de material crítico, y la diagnosis genérica y específica dada por el autor (errónea y poco precisa) crearon una confusión en la interpretación de *Relchela*.

Sus caracteres quedan perfectamente bien definidos por la posición y número de antecios (1–2), compresión lateral y consistencia perfectamente indurada de la glumela, apenas 5–7-nerviada, callo robusto, coronado de pelos tiesos, raquilla prolongada y pubescente, caryopsis hirsuto en el ápice e hilio basal, lanceolado-linear. Consideramos *Relchela panicoides* perteneciente a la tribu Festuceae, sub-tribu Festucinae.

El género y la especie son endémicos en Chile, con una distribución geográfica comprendida entre Aconcagua y Llanquihue, desde la costa al valle central. La época de floración, de acuerdo con el material que nos ha sido posible estudiar, varía desde Diciembre a Febrero.

Durante la disección de las espiguillas de un solo antecio, notamos la presencia de caryopsis completamente desarrollados y anteras de tamaño muy reducido, que agrupadas y entremezcladas con el resto de estigma coronaban su ápice. La glumela y la palea se unían por sus bordes fuertemente, y la separación de la primera se hacía dificultosa debido a su consistencia estremadamente coriácea. Este hecho nos hace reconocer un fenómeno de cleistogamía en esta clase de elementos. Hemos tratado de ilustrar esta característica, común en otros géneros americanos, en la lámina que adjuntamos, en la que puede apreciarse el tamaño de las anteras en los antecios cleistógamos y aquellos normales.

En el material estudiado, la especie encierra también un complejo de variaciones, que aparentemente podrían tomarse como fijos. Por ejemplo, la glumela se presenta algunas veces completamente escabra en la mitad inferior (*Buchtien,* Valparaiso, US. no. 1099593); otras veces, la forma generalmente aovada de la glumela se inclina a lanceolada (*Joseph 5113*). Los antecios son en la mayoría de los especímenes más cortos que las glumas; en cambio en el material citado anteriormente el primer antecio tiene el mismo largo que las glumas y el segundo sobresale bastante de ellas, lo que afirma su posición dentro de la tribu. La palea es más corta que la glumela y otras veces de su misma dimensión. La longitud de las anteras presenta ligeras variaciones respecto de las anotadas.

Hemos creído necesario dar a conocer en detalle la discusión de cada

uno de los tipos y presentar una diagnosis completa basada en material crítico, con el fin de aclarar su valor taxonómico.

Relchela panicoides Steudel, Syn. Pl. Gram. **1**: 101. 1854.

El tipo se encuentra conservado en el Herbario del Museo de París. El ejemplar colectado por Lechler, no. *435,* Arique, Chili, Dc. 51, con la etiqueta de Lechler, lleva otra que dice, "*Relchela panicoides* Steudel (*Lechlera,* seguido de un nombre específico inédito), *Lechlera* Miq. est aliud genus. Prope Arique Chili. *Lechler* Hrbr. no. *435*" [manuscrito del autor]. Está formado por dos ejemplares de 60 cm. de altura (culmo de uno de ellos quebrado), perenne; grupos pequeños de pocos a varios culmos; hojas lacias, aplanadas, de 3 mm. de ancho; panículas sobremaduras, de 5–9 cm. Las espiguillas llevan un solo antecio; el ovario completamente desarrollado, y anteras pequeñas coronando su ápice. Una segunda hoja correspondiente al mismo colector y número la forman ejemplares pequeños, más jóvenes; culmos de 25–40 cm., designados por Steudel con un nombre varietal inédito.

Isotipos de la especie se encuentran (1) en U. S. National Herbarium (US. no. 1127141), ex Wien. Nat. Mus. (W). "W. Lechler pl. chilensis. Ed. R. F. Hohenacker, *435, Relchela panicoides* Steudel, novum. Panicearum genus, *Relchela* anagramma e Lechlera, prope col. Arique et pr. Techa. Dec. m. 1851." Es un ejemplar completo bien conservado, de dos culmos y mostrando la presencia de estolones; (2) en el Jardín Botánico de Leningrado (LE), fragmento en US., obtenido por Hitchcock, en 1907; (3) en el Herbario de Cambridge, Inglaterra (CGE), Chili (Arique) *Lechler 435,* obtenido por Prof. Hitchcock; (4) en el Herbario Pittier & Durand, Bruselas (BR) (*Lechlera,* seguido del mismo nombre específico inédito), "*Relchela panicoides* Steudel" Valdivia, Chili, *Lechler* (Hohenacker) *435,* nombre manuscrito por el autor; fragmento obtenido por Hitchcock en 1935; (5) en el Herbario del Museo Nacional de Historia Natural, Santiago, Chile (SGO), Herbario Philippi. Según Espinosa[3] existe otro ejemplar colectado en "Arique (Valdivia) en 1851." También en US. no. 1761967, en hoja separada, se encuentran 4 ejemplares completos, de panículas delgadas y reducidas, W. Lechler pl. chilensis, Ed. R. F. Hohenacker, *435, Relchela panicoides* Steudel, n. gen., "in virgultus prope Arique. Novembr.m.1853" (Nótese que el año, mes y anotaciones difieren de la etiqueta considerada original).

Planta perenne, raíz fibrosa, estolonífera, innovaciones extravaginales, 20–60 cm. de altura, formando grupos de pocos o varios culmos. Estos

[3]Según M.R. Espinosa, también existe bajo esta misma denominación en SGO un ejemplar colectado en "Huallihuapi" ad originem Rio Futa (Valdivia).

cilíndricos, erectos o algo geniculados en la base,[4] de 0.8–1 mm. de diámetro, retrorso-escabros, de 2 nudos visibles, separados entre 12–13 cm., circulares, negruzcos, de 0.3 mm. de ancho, desnudos. Vaina glabra o muy escasamente pubescente, amarillenta, estriada, más corta que la lámina, 4–10 cm., envolviendo o no por completo el culmo. Lígula 2 mm. de largo, blanquecina, membranosa, pubescente al interior, decurrente sobre la vaina. Lámina plana, la inferior 15–20 cm., 2–3 mm. de ancho, lanceolada-acuminada, de 13–15 nervios prominentes, escariosos; la superficie inferior de las más maduras cubierta en los nervios de apéndices largos, blanquecinos, separados. Algunas veces, la lámina superior del culmo de 6 cm. de largo, alcanzando a la mitad de la panoja. Panícula contraída, erecta, 4–8 cm., por 3–5 de ancho; las ramificaciones escariosas, ascendientes, en verticilos de 3–5, separados entre 1.5–2 cm.; el verticilo más corto de 0.5 cm., y el más largo de 2 cm.; cada ramificación principal o secundaria desnuda inferiormente. Espiguillas 1–2 antecios, el primero sésil, incluído por completo por las glumas, el segundo en una raquilla igual a la mitad del primero, ambos hermafroditas. Glumas aquilladas, casi iguales, de márgenes membranosos, transparentes, de bordes enteros o muy finamente aserrados; carena escariosa; la inferior de 4–4.5 mm. y 0.5 mm. de ancho, 1-nerviada; la superior 4.3–4.5 mm. y 0.5 mm. de ancho, 3-nerviada en su base. Glumelas cilíndricas y dorso encorvado, 3.3–3.5 mm. y 0.4 mm. de ancho, de ápice obtuso, y el nervio medio no sobresaliendo entre los lóbulos de ella, induradas, gruesas, con la base coronada de pelos cortos, de bordes escariosos, lisa inferiormente, algo escariosa hacia el extremo, 5–7-nerviada, oscuramente así; los antecios lateralmente comprimidos. Palea 2-nerviada, más corta que la glumela ó del mismo largo, 2.6–3.1 mm. de largo, por 0.5 mm. entre los nervios; estos escariosos o casi ciliados hacia el vértice, el ápice entero. El segundo antecio 2.3 mm., igual en estructura al inferior, con la palea del mismo largo que la glumela. Estambres 3, con los filamentos ¼ más cortos que las anteras, éstas 1.7–2.2 mm. de largo. El callo robusto, redondeado, amarillento, estrangulado hacia la base de la glumela, bordeado por pelos blancos, tiesos, cortos de no más de 0.5 mm. Ovario 0.5 mm., angosto hacia la base, con el estigma poco plumoso, 1.8 mm.; estilos cortos y aplanados, naciendo separados. Caryopsis hirsuto en el ápice, 1.2 mm. y 0.4 mm. de ancho, subtriangular, de surco más o menos profundo; hilio lanceolado-linear, negruzco. Lodículos bilobulados, con uno de ellos más corto y colocado lateralmente, 1 mm. de largo, y 0.3 de ancho.

[4] *Panicum oligostachium* (según descripción) Fr. Vidal Gormaz, Maullín en 1874.

Panicum oligostachium Steudel, Syn. Pl. Gram. **1**: 97. 1854.

Hemos estudiado un ejemplar del Herbario Steudel, Museo de París, que lleva en la etiqueta el nombre manuscrito por el autor, seguido de: "prope Conception, Chili, legit Urville"; se trata de un espécimen pobre, obtenido por Mrs. Chase en 1935.

Isotipo de la especie, en el Herbario de Caen, Francia (CN); la etiqueta dice: "Chauvin 1851, Hb. Urville, Chile,"[5] que le suponemos como tal. No lleva indicaciones manuscritas por el autor. Se trata de un ejemplar pequeño, de más o menos 12 cm. de altura. Chase, 1935.

Ramificaciones de la panoja verticiladas, con 2–4 ramificaciones escabras; la espiguilla de dos antecios, 3.4 mm. de largo, de pedicelo escarioso; gluma inferior 3.7 mm. y 0.5 mm. de ancho, 1-nerviada, escariosa en la mitad superior y borde finamente aserrado; gluma superior 3-nerviada, escariosa como la primera de 3.5 mm., y 0.8 mm. de ancho; antecio de 3 mm. por 0.6 mm. de ancho, coronado por pelos en su base, lanceolado-oblongo. Glumela levemente 7-nerviada, 0.7 mm. de ancho, escariosa; palea de 2 mm. de largo y 0.5 mm. de ancho, 2-nerviada, francamente escarioso-pubescente en los bordes. El segundo antecio 1.8 mm., 0.5 mm. de ancho; la proporción entre palea y glumela es la misma como en el primer antecio. Anteras 0.4 mm. de largo, con el filamento muy corto. Ovario 0.4 mm. de largo, escasamente pubescente. El segundo antecio en este espécimen es más pequeño que en el material observado anteriormente, y la palea del primer antecio difiere por su longitud notablemente más corta.

Agrostis ? asperula Phil. Linnaea **29**: 89. 1857–58.

Desconocemos dónde pueda encontrarse el tipo de Philippi, pero su descripción concuerda en todos sus caracteres con *Relchela*. El autor indica su posición dudosa en *Agrostis*. Pilger (19) dice haber observado un espécimen determinado por Philippi como tal, pero cuyas espiguillas llevan un solo antecio. El ejemplar citado más adelante, también determinado por Philippi, concuerda más con su descripción (NY). En el Museo de Santiago (SGO), Espinosa[6] nos da cuenta que ejemplares bajo esta especie existen dos: uno de Puyehue, Prov. Valdivia, y otro de San Juan, Mirador, Enero de 1865, que difieren de la localidad original del tipo.

Agrostis limonias Phil. Linnaea **33**: 287. 1864–65.

El tipo de esta especie se encuentra conservado en el Herbario Hackel,

[5]Chauvin fué el médico del barco en la Expedición comandada por D'Urville. Probablemente los especímenes de este último fueron colectados por Chauvin.

[6]Carta fecha 29 de Enero, 1940.

Museo de Viena (W). Nos ha sido posible estudiar un fragmento de él y una fotografía del mismo ejemplar. La etiqueta dice: Pantanos [Manuscrito de Philippi] *Agrostis limonias* Ph. Valdivia [Manuscrito de Reiche]. Además no. 150, que corresponde al envío de material efectuado por el Museo Nacional de Santiago al Prof. E. Hackel. El espécimen se compone de un solo culmo quebrado, y sus vainas alcanzan casi hasta la altura de la panícula; las espiguillas de color amarillo claro. La gluma inferior de 3.5 mm., la superior casi del mismo largo. Antecio de 2.8 mm., visiblemente coronado por un círculo de pelos tiesos. La glumela difiere un tanto del ejemplar de Lechler por tener la superficie de su mitad inferior casi completamente lisa y brillante, de color amarillo pálido. Anteras 1–1.2 mm., flavas. Palea 2.5 mm. por 0.4 mm. de ancho, escariosa hacia arriba, los nervios casi paralelos en la mitad. La raquilla pubescente, de 2 mm. de largo.

Agrostis ?? corralensis Phil. Linnaea **33:** 286. 1864–65.

Hemos estudiado fotografía y fragmento de un ejemplar, conservado en el Herbario de Viena (W). Ejemplares de esta especie no se encuentran representados en Santiago. La etiqueta dice: "Agrostis corralensis Ph. no. 161,[7] Valdivia" [en manuscrito de Reiche]. La fotografía muestra un espécimen de un solo culmo, desprovisto de la parte basal. Las vainas alcanzando hasta el nacimiento de la panícula; las láminas son anchas, planas, lanceoladas, acuminadas, notablemente estriadas. En general este material aparece más robusto que los otros especímenes estudiados. Espiguillas de 2 antecios, de 4 mm. de largo; el primer antecio 3.5 mm. por 1.6 mm. de ancho, 3-nerviado, muy oscuramente 5-nerviado, escarioso, de ápice angostamente obtuso; palea 2-nerviada, escariosa en sus ¾ superiores, 3 mm. de largo y raquilla 0.8 mm. de largo. El segundo antecio 3 mm., escarioso, raquilla 2 mm. de largo, pubescente. La raquilla del primer antecio es ensanchada en su término y está provista de abundantes pelos blancos, que la sobrepasan en su mismo largo. Anteras del primero 1.5–2 mm.; ovario 0.5 mm., no desarrollado, pubescente; lodículos 1 mm. de largo, 0.3 mm. de ancho.

Las dimensiones anotadas en las descripciones son las correspondientes a material observado en seco. Los órganos florales (sexuales) y lodículos fueron observados después de remojar los antecios durante 3 a 5 minutos en agua caliente, agregando 2 o 3 gotas de glicerina. Las abreviaciones empleadas para los diferentes herbarios son aquellas publicadas por *Chronica Botanica* (**5:** 142–150. 1939), de acuerdo con la standarización que se quiere establecer en este sentido.

[7]Numeración correspondiente al material enviado a Viena.

Ciertos ejemplares presentaban pústulas negruzcas sobre las láminas, que corresponden al patógeno *Phyllachora graminis* (Pers.) Fkl., de la familia Dothideaceae, indicando con ello un nuevo mesonero para este hongo.[8]

La comparación del tipo de *Agrostis sesquiflora* Desv.,[9] conservado en el Museo de París, y del cual hemos observado fragmentos, nos lleva a la conclusión que la combinación nueva de Pilger, establecida recientemente, *Briza* (§ *Relchela*) *sesquiflora* (Desv.) Pilger, no tiene base. Desvaux (10) al término de la diagnosis dice que el rudimento del pedicelo de una segunda flor es siempre más corto que la cuarta parte de la palleta inferior, algunas veces pestañado en el vértice, y pocas líneas antes dice que las espiguillas son ovales, uniflores, presentando generalmente un rudimento del pedicelo de segunda flor.

La primera de estas citaciones de la diagnosis dada por Desvaux ha servido seguramente de base para que la interpretación del rudimento de segunda flor quede relacionada a nuestra *Relchela panicoides*. Sin embargo, *Agrostis sesquiflora* Desv. está afortunadamente muy bien definido e ilustrado en la Flora de Claudio Gay, y evidentemente nada existe de común con *Relchela*.[10] *A. sesquiflora* alcanza de 30–35 cm.;[11] láminas 5–7.5 cm. de largo, 1.5–2 mm. de ancho, vainas lisas; panojas 5–7.5 cm.; espiguillas estrictamente unifloras con un rudimento de raquilla angosta, cilíndrica, que alcanza a la cuarta parte de la glumela; glumas uninerviadas, 2–2.5 mm.; glumela 1, 5-nerviada, membranosa, delgada, 2 mm. de largo; palea de la misma consistencia que la glumela, 2-nerviada, más corta y truncada en el vértice; callo glabro; lodículos oval-alargados, enteros; anteras 0.4–0.5 mm. de largo; ovario ovoideo con los estilos naciendo casi juntos; caryopsis cilindroideo, de 1 mm., glabro, de hilio punctiforme.

El rudimento de segunda flor de las especies de *Agrostis* ha sido también observado en algunas especies norteamericanas, e Hitchcock (13) lo expresa como caracter fundamental en su clave.

Por otro lado — y esto hasta donde nos ha sido posible observar —

[8]Determinación del Dr. Annie E. Jenkins, del Departamento de Agricultura, Washington, D. C., y comprobado por el Dr. E. R. Orton, especialista en el género.

[9]El tipo de Desvaux se compone de 4 especímenes y 4 culmos extras, una base mostrando un rizoma delgado, rastrero, 2.5 cm. de largo; los culmos de 18–30 cm. de altura, hojosos en la base láminas planas, flexibles; las panículas de 4.5–7 cm., todas angostas pero sueltas. La etiqueta tiene anotado: "Desv. 3, *Agrostis sesquiflora* nob. Em. Desvx." [manuscrito del autor]. En etiqueta de Gay: "185 m.ch.antuco Chili (Province de....)."

[10]Serán considerados sinónimos de esta especie: *Briza sesquiflora* (Desv.) Pilger y *Deyeuxia sesquiflora* (Desv.) Benth. & Hook. f. ex Jackson.

[11]*Claudio Joseph 4229*, Yumbel, Jan. 1928 (US. no. 1423582); Herb. R. A. Philippi, s.n., Baños de Chillán, Jan. 1877 (US. no. 556343).

Agrostis sesquiflora parece ser una especie que habita la alta cordillera andina. Nuestra especie, en cambio, queda localizada principalmente en el valle central y los cordones de la cordillera de la costa.

MATERIAL ESTUDIADO.

VALPARAÍSO: *Otto Buchtien s.n.*, Valparaíso, Agosto, 1894 (US. no. 1099593). CURICÓ: *Claudio Joseph 4269*, Curicó, Enero, 1928 (US. no. 1423606); *Claudio Joseph 4254*, Curicó, Enero, 1928 (US. no. 1423597). CONCEPCIÓN: *Claudio Joseph 5714*, Concepción, Nov. 1927 (US. no. 1423625); *Claudio Joseph 4602*, Concepción, San Pedro, Oct. 1926 (US. no. 1299006); *Claudio Joseph 182*, Concepción, Oct. 1925 (US. no. 1258854); *F. W. Neger s.n.*, Concepción (US. no. 1129015); *Claudio Joseph 4212*, Tomé, Nov. 1929 (US. no. 1283793); *Claudio Joseph 5713*, Concepción, Nov. 1927 (US. no. 1423624). MAULE: *R. A. Philippi 559*, Prov. Maule (US. no. 1761968). ÑUBLE: *E. W. D. & M. M. Holway 277*, Recinto, Jan. 1920. CAUTÍN: *Claudio Joseph 4664*, Temuco, Dec. 1926 (US. no. 1299005); *E. W. D. & M. M. Holway 167*, Temuco, Nov. 1919. VALDIVIA: *Otto Buchtien, s.n.*, Valdivia, Sept. 1905 (US. no. 1099592); *H. Gunckel 2812*, Cerros del Bolsón, Corral, Dec. 1931 (US. no. 1538160); *H. Gunckel 1512*, Amargos, Feb. 1930 (US. no. 1502456); *Claudio Joseph 2644*, Panguipulli, Enero, 1924 (US. no. 1198570). LLANQUIHUE: *Fr. Vidal Gormaz s.n.*, Maullín (SGO. no. 226). SIN LOCALIDAD: *R. A. Philippi* (SGO. no. 589) (US. no. 556334); *R. A. Philippi* (SGO. no. 20) (US. no. 1761969); *Philippi*, Chile (NY).

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SUMMARY

(1) The genus *Relchela* Steudel has been ignored or misinterpreted since its erection, and its only species, *Relchela panicoides* Steudel, has been considered an anomalous species of *Agrostis*, *Calamagrostis*, and more recently as the type-species of a new section of *Briza*.

(2) Because of its well-defined floral characters, *Relchela* has a definite phylogenetic and taxonomic status and belongs to the tribe Festuceae, subtribe Festucinae.

(3) *Agrostis sesquiflora* Desv. and *Relchela panicoides* Steudel being

compared with *Briza sesquiflora* (Desv.) Pilger, based on the former, Pilger's combination is invalid.

(4) A new diagnosis is given for critical type-material and isotypes, and a new synonymy as well.

(5) Spikelets formed by a single floret are interpreted as cleistogamous elements.

(6) The species is a host to *Phyllachora graminis* (Pers.) Fkl.

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EXPLICACION DE LA LAMINA

Fig. A. Habitat, Vidal Gormaz, año 1874. × 1.

Fig. 1. Espiguilla mostrando los dos antecios y la raquilla pubescente.

Fig. 2. Primer antecio.

Fig. 3. Segundo antecio y prolongación de la raquilla.

Fig. 4. Palea vista ventralmente.

Fig. 5. La misma desde el dorso. [Dibujados del tipo, × 20].

Fig. 6. Caryopsis normal × 40 (*Joseph 5819*).

Fig. 7. Caryopsis de elementos cleistogámicos × 40 (Tipo).

Fig. 8. Organos sexuales × 20 (Isotipo, Hb. Pittier & Durand).

Fig. 9. Lodículos de los mismos × 20.

Fig. 10. Mapa mostrando la distribución geográfica en la parte centro-sur de Chile.

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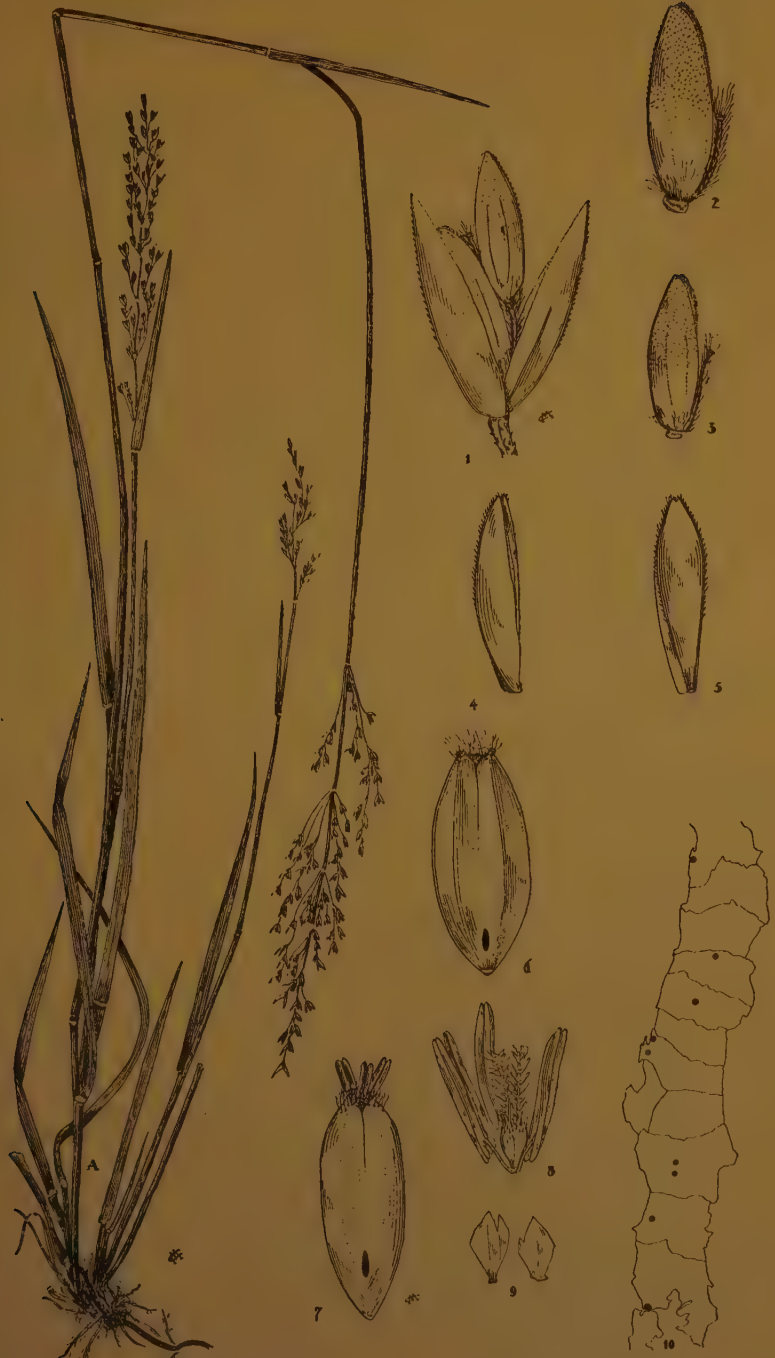

RELCHELA PANICOIDES Steudel

CHROMOSOME BEHAVIOR IN CATALPA HYBRIDA SPAETH

E. Chalmers Smith*

According to Seward (1931), the genus *Catalpa* Scop. of the Bignoniaceae is represented in fossil deposits in what was an Oligocene river estuary on the Isle of Wight. There is reason to believe that the genus, in common with other genera of that time, was more widely distributed then than now.

Catalpa is now represented by about ten species in North America, the West Indies and eastern Asia (Rehder, 1940). *Catalpa ovata* Don is native to China and is a cultivated tree in Japan. *Catalpa bignonioides* Walt. and *C. speciosa* Warder are both North American species. These three are the common cultivated catalpas of this region.

A natural hybrid appeared when *C. ovata* was introduced into this country in 1849 and was planted near the native species in Indiana (Sargent, 1889). This hybrid was thought to be the cross *C. ovata* × *C. bignonioides* and is known as *Catalpa hybrida* Spaeth (Teas' Hybrid Catalpa). According to Sargent this tree is more vigorous and of more rapid growth than either the American or the Chinese parent. It sets good crops of seed and shows segregation in the F_2 generation.

In 1911 Dr. E. M. East made the reciprocal cross, *C. bignonioides* × *C. ovata* at the Connecticut Experiment Station. This cross resulted in a numerous progeny identical with the natural hybrid, very vigorous, and five to ten times more productive in amount of seed produced than either parent. These seeds were well developed and fertile. A sample tested in the incubator gave 51% viability (Jones and Filley, 1920).

The fact that this species hybrid is fertile and segregates in the second generation indicates that the parents probably have the same chromosome number and that their chromosomes are similar in structure. The haploid chromosome number of *C. syringaefolia* Sims (= *C. bignonioides* Walt.) has been reported by Scheu to be = 20 (Tischler, 1936). Aceto-carmine smears of pollen mother cells from *C. ovata*, *C. bignonioides*, and *C. hybrida* clearly show the haploid number of chromosomes to be 20. In addition, smears of seedling root tips of *C. speciosa* show the diploid number in this species to be 40. Up to this time few chromosome numbers have been determined in this large

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family. The haploid chromosome number of 20 seems to be common to one other genus, *Campsis* Lour. (Sax, 1933).

The chromosomes of *C. ovata* and *C. bignonioides* pair regularly and show no irregularities in any stage of the meiotic divisions or microspore formation. Both species are highly fertile, showing from 90–95% morphologically good pollen in counts of 2000 pollen grains. *Catalpa hybrida* exhibits a similar behavior. The chromosomes pair regularly at the first meiotic division and there is no evidence of lagging chromosomes or inversion bridges at either the first or second meiotic divisions. Neither is there any indication of polyspory. The fertility of this hybrid corresponds to that of the parent species. These conclusions are based upon the examination of twenty-five metaphase and anaphase plates of each of the meiotic divisions for the species concerned.

The species *C. ovata* of eastern Asia and *C. bignonioides* of North America have evidently been isolated for a long period of time, and yet their chromosomes seem to have undergone no fundamental change in structure. There seems some reason to believe that a similar condition exists in the case of *C. ovata* and *C. speciosa,* for a cross made between these two species in the Arnold Arboretum in 1940 has set a quantity of well developed seed.

Among the reports of fertile F_1 hybrids between geographically isolated species which have appeared in the literature are those of several hybrids between woody species. *Platanus acerifolia* (Ait.) Willd., a hybrid between *P. occidentalis* L. and *P. orientalis* L., shows complete chromosome pairing and segregation at meiosis accompanied by high fertility (Sax, 1933). *Larix eurolepis* Henry, the hybrid *L. leptolepis* (Sieb. and Zucc.) Gord. (= *L. Kaempferi* Sarg.) × *L. decidua* Mill. represents a cross betweeen a Japanese and an European species. A study of meiosis in this hybrid (Sax, 1932) shows almost complete pairing of the chromosomes with about 9% morphologically imperfect pollen as opposed to complete pairing and 2–3% morphologically imperfect pollen found in the parent species. In addition the average chiasma frequency is approximately the same in both parents and the hybrid. *Campsis Tagliabuana* (Vis.) Rehd., a hybrid between an Asiatic and a North American species, shows complete chromosome pairing but is partially sterile.

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A NOTE ON THE DATES OF PUBLICATION OF WIGHT'S "ICONES PLANTARUM INDIAE ORIENTALIS."

E. D. MERRILL

THE basic information on the dates of issue of the various parts of this important work, consisting as it does of 2101 plates and accompanying descriptive text, is that supplied by Wight himself.* In the preface to the last volume, dated January 20, 1853, he states that the last part was issued in March, 1853. Here he gives the year and the month of issue of most of the parts, and his data, which are frequently overlooked except by experienced bibliographers, are repeated below, for even Pritzel, "Thesaurus" ed. 2, 346, no. 10246. 1877, gives only the inclusive dates 1840–56 for the six volumes, although in the first edition of that work, 1851, p. 322, no. 11222, he does give the dates of publication of the first three volumes as **1**(1838–40), **2**(1842), and **3**(1843–47). Wight's data are repeated below, verbatim:

"Vol. I.

Nos. 2, 3, (Plates 21–60)	Sept. 1838.
Nos. 4, 5, (61–100)	Nov. 1838.
Nos. 6, 7, 8, (101–161)	June 1839.
No. 9, (162–181)	Aug. 1839.
No. 10, (182–201)	Sept. 1839.
Nos. 11, 12, (202–241)	Nov. 1839.
Nos. 13, 14, (242–279)	Feb. 1840.
Nos. 15, 16, (280–318)	May 1840.
Vol. II.	
(319–736)	1840–1843.
Vol. III.	
Parts I. II. III. (737–1046)	1843 to Nov. 1845.
Part IV. (1047–1162)	Sept. 1846.
Vol. IV.	
Part I. (1163–1282)	Jan. 1848.
Part II. (1283–1403)	Aug. 1848.
Part III. (1404–1501)	Apr. 1849.
Part IV. (1502–1621)	May 1850.
Vol. V.	
Part I. Orchideae, (1622–1762)	May 1851.
Part II. (1763–1920)	Jan. 1852.
Vol. VI.	
(1921–2101)	Mar. 1853."

*WIGHT, R. Icones plantarum Indiae Orientalis **6**: viii. 1853.

The record is complete except for volume one, number one (plates 1–20), volume two (parts 1–4, plates 319–736), and volume three (parts 1–3, plates 737–1046). A fascicle cover for volume 1, no. 1, is dated 1838, and in his prospectus Wight states that no. 1 was to appear in July of that year; thus 1838 can safely be accepted as the date of issue of this part.

It is worthy of note that the first twenty plates forming number one bear the numbers 35, 73, 160, 171, 176, 178, 189, 197, 198, 198[bis], 198[ter], 205, 334, 339, 341, 342, 396, 467, 513, and 723. These figures apply to the numbers of the species as described in Wight and Arnott's "Prodromus" published in 1834. These plates, in sequence, should be numbered 1 to 20, for while Wight added the forms $\frac{1}{35}$, $\frac{2}{73}$, $\frac{3}{180}$, etc., in his published explanations of the plates and brief descriptions, he did not commence to print these fractional forms on the plates until number two appeared. This system of numbering is obscure until one realizes that where the fractional form of numbering appears on the plates and in the text, the numerator represents the sequence of plate numbers for the "Icones" (this to be cited), and the denominator is the species number in Wight and Arnott's "Prodromus florae Indiae Orientalis" (1834).

After number one appeared, Nathaniel Wallich, then Superintendent of the Botanic Garden at Calcutta, placed at Wight's disposal the unpublished drawings prepared under the direction of William Roxburgh, and now preserved in the library of that institution. The use of these Roxburgh drawings is explained by Wight in a notice issued with the second number of the "Icones"; these illustrations, as reproduced by Wight, all bear the legend "Roxburghianae." This is mentioned to emphasize the importance of these particular illustrations, for they graphically represent numerous species actually described by Roxburgh in his "Flora Indica" ed. 1, **1**(1820), **2**(1824), and ed. 2, **1–3**(1832).

Wight's original plan of publication was to issue twenty plates, with descriptive text, as individual numbers, and this plan was approximately followed for those parts forming volume one. Beginning with volume two this plan was changed to one involving fewer and larger parts, the four forming volume two containing from 98 to 116 plates each, this system being continued to the end of the work. In reference to volume two, I have no information as to the dates of issue other than Wight's own statement (Icones **6**: viii. 1853) that of volume two, plates 319–736 were issued from 1840 to 1843; the title page date is 1843. As plates 319–416 form part one, we can rather safely assume that this part was issued in 1840. Part four includes plates 632 to 736 and clearly appeared in 1843. This leaves plates 417 to 631, forming parts two and three, for

which more definite dates of issue are as yet unknown, other than the inclusive period 1840–43, although it seems probable that they may have been issued in 1841–42.

For volume three it is now possible to add some supplementary information regarding the dates of issue from a fascicle cover, and its accompanying notice, recently received at the Arnold Arboretum. Wight states (Icones 6: viii. 1853) that parts one to three of this volume appeared from 1843 to November 1845. The fascicle cover of number one of volume three bears the printed date 1843, but it was clearly not issued until 1844. In the notice accompanying this part, in explaining the delay in the issue of his "Illustrations of Indian Botany," Wight states regarding the latter: "Immediately on publication of the last part [of the "Illustrations"] published (Part 1, Vol. 2) he was under the necessity of packing up the whole of his collections preparatory to leaving Madras and *up to the present hour, (May 1, 1844)* [italics mine] the greater part of them are unavoidably still in the packing cases." Thus part one of volume three of the "Icones" could not have been issued *before May, 1844*. As the list on the inside of the back cover of the fascicle cover included plates 737 to 815, we can safely assume that the year of publication of these was 1844 (not 1843), and probably in May of that year. For volume three, part three, plates 618 to 930, and the text of plates 931 and 932, repeated in volume three, part two, no additional data are available other than that the part was issued in 1844–45. Part three, including plates 931 to 1046, appeared in November, 1845 (Wight's own statement), and the remainder of the volume, plates 1047–1162, in September, 1846* (again Wight's own statement).

Summarizing we can thus narrow the dates of publication of the parts discussed, as follows:

Vol. 1, No. 1, pl. 1–20	(July?)	1838
Vol. 2, Part 1, pl. 319–416		1840
Part 2, pl. 417–514		1840–43 (probably 1841)
Part 3, pl. 515–631		1840–43 (probably 1842)
Part 4, pl. 632–736		1843
Vol. 3, Part 1, pl. 737–815	(May?)	1844
Part 2, pl. 816–930		1844–45
Part 3, pl. 931–1046	(Nov.)	1845
Part 4, pl. 1047–1162	(Sept.)	1846

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*PRITZEL, G. A. Thesaurus literaturae botanicae ed. 1, 322, no. 11222, 1851, states that volume three, parts 1 to 4, plates 737–1162, appeared in 1843–47. It has been shown above that the first part, plates 737–815, could not have appeared before May, 1844, but the last part, plates 1047–1162, may not have been issued until 1847.

LEDEBOUR'S "FLORA ROSSICA," "ICONES PLANTARUM NOVARUM," AND "FLORA ALTAICA," WITH A NOTE ON PALLAS' "FLORA ROSSICA."

William T. Stearn

Among the many German naturalists who labored under the Tzars and Tzarinas of Russia to make known the vegetation and fauna of that vast realm, Carl Friedrich von Ledebour (1785–1851) holds an honored place for being the first man to complete a comprehensive flora, one with detailed descriptions and synonymy, covering northern Asia, the Caucasus, and Alaska, as well as European Russia. Such a work, with colored folio plates and on too grand a scale ever to be finished, was begun by Catherine the Great's favorite, Peter Simon Pallas (1741–1811), but only two parts of his *Flora Rossica* were published. Ledebour's *Flora Rossica sive Enumeratio Plantarum in totius Imperii Rossici Provinciis Europaeis, Asiaticis et Americanis*[1] *hucusque observatarum* is in more modest but more practical octavo format, without illustrations but including a map. Its publication began at Stuttgart in 1841 and ended in 1853, two years after Ledebour's death. Alexander von Bunge (1803–1890) wrote the account of *Pedicularis;* Eduard Fenzl (1808–1879) the account of Alsineae, Amarantaceae, *Gypsophila*, Paronychieae, Phytolaccaceae, Salsolaceae, Scleranthеae; August H. R. Grisebach (1814–1879) the account of Gramineae; Ernst H. F. Meyer (1791–1858) the account of Juncaceae; Ludolph Christian Treviranus (1799–1864) the account of Carex. According to Trautvetter, it includes 6522 species (5398 Dicotyledons, 1040 Monocotyledons, 84 Cryptogams). Few botanists are aware that this work, like many other floras, came out in parts; hence citations from it are not always correctly dated. The contents of the parts of Ledebour's *Flora Rossica* and their probable dates of issue as revealed by contemporary notices, notably those in the weekly *Allgemeine Bibliographie für Deutschland* (Leipzig), *Botanische Zeitung* (Berlin), J. C. Hinrichs, *Verzeichniss neuer Bücher* (Leipzig), and the *Leipziger Repertorium der deutschen und ausländischen Literatur, herausgegeben von E. G. Gersdorf* (Leipzig), are as follows:

[1]"America Rossica," i. e. Alaska, did not become United States territory until 1867.

VOLUME 1

	Contents	*Date*	*Authority*
Fasc. 1.	text pp. 1–240, Conspectus pp. 1–8, Praefatio etc. pp. iii–xvi	1841 (late)	Hinrichs, Verz. Juli–Dec. **1841**: 148; Gersdorf, Rep. **32**: 234 (1842).
Fasc. 2.	text pp. 241–480, Conspectus pp. 9–16	1842 (probably October)	Baillière invoice to British Museum dated 18 Nov. 1842; Flora **25**, II: 765 (Dec. 1842); Hinrichs, Verz. Juli–Dec. **1842**: 145; Leipz. Rep. **1**, I: 333 (Feb. 1843); Archiv. f. Naturg. **8**, II: 416 (1843).
Fasc. 3.	text pp. 481–790, Conspectus pp. 17–22	1843 (probably March)	Allg. Bibl. **1843**: 116 (27 April 1843); Bot. Zeit. **1**: 402 (June 1843); Hinrichs, Verz. Jan.–Juni **1843**: 115.

VOLUME 2

Fasc. 4.	text pp. 1–204	1843 (probably September)	Bot. Zeit. **2**: 730 (18 Oct. 1843); Allg. Bibl. **1843**: 348 (16 Nov. 1843); Hinrichs, Verz. Juli–Dec. **1843**: 127; Leipz. Rep. **1**, IV: 456 (Dec. 1843).
Fasc. 5.	text pp. 205–462	1844 (probably July)	Allg. Bibl. **1844**: 252 (15 Aug. 1844); Bot. Zeit. **2**: 730 (Oct. 1844); Hinrichs, Verz. Juli–Dec. **1844**: 144; Archiv. f. Naturg. **10**, II: 378 (1844).
Fasc. 6.	text pp. 463–718, Conspectus pp. 1–13	1845 (probably August)	Bot. Zeit. **3**: 617 (12 Sept. 1845); Allg. Bibl. **1845**: 308 (2 Oct. 1845); Leipz. Rep. **3**, IV: 195 (Oct. 1845); Hinrichs, Verz. Juli–Dec. **1845**: 139.
Fasc. 7.	text pp. 719–937, Conspectus pars 2 pp. 1–12, Fl. Ross. Fontes pp. i–vi.	1846 (probably August)	Bot. Zeit. **4**: 621 (4 Sept. 1846); Allg. Bibl. **1846**: 300 (17 Sept. 1846); Leipz. Rep. **4**, IV: 76 (Oct. 1846); Hinrichs, Verz. Juli–Dec. **1846**: 136.

VOLUME 3, part 1

	Contents	*Date*	*Authority*
Fasc. 8.	text pp. 1–256	1847 (probably October)	Allg. Bibl. **1847**: 364 (4 Nov. 1847); Bot. Zeit. **5**: 871 (Dec. 1847); Hinrichs, Verz. Juli–Dec. **1847**: 163.
Fasc. 9.	text pp. 257–492, Conspectus pp. 1–13	1849 (probably June)	Allg. Bibl. **1849**: 220 (12 July 1849); Leipz. Rep. **7**, III: 238 (July 1849); Hinrichs, Verz. Juli–Dec. **1849**: 130; Wikström, Årsberätt. **1849**: 125 (1852).

VOLUME 3, part 2

Fasc. 10.	text pp. 493–684, Conspectus pp. 1–4	1850 (probably November)	Allg. Bibl. **1850**: 461 (5 Dec. 1850); Wikström, Årsberätt. **1850**: 139 (1854); Leipz. Rep. **9**, I: 113 (Jan. 1851); Hinrichs, Verz. Jan.–Juni **1851**: 144; Bot. Zeit. **9**: 199 (March 1851).
Fasc. 11.	text pp. 685–863, Conspectus pp. 5–8	1851 (probably December)	Allg. Bibl. **1852**: 9 (8 Jan. 1852); Hinrichs, Verz. Jan.–Juni **1852**: 149; Bot. Zeit. **10**: 134 (Feb. 1852); Wikström, Års-berätt. **1851**: 103 (1855).

VOLUME 4

Fasc. 12.	text pp. 1–240	1852 (probably April)	Allg. Bibl. **1852**: 160 (20 May 1852); Hinrichs, Verz. Jan.–Juni **1852**: 149; Bot. Zeit. **10**: 723 (Oct. 1852); Leipz. Rep. **10**, III: 52 (1852); Wikström, Årsberätt. **1851**: 111 (1855).
Fasc. 13.	text pp. 241–464	1852 (probably September)	Allg. Bibl. **1852**: 379 (21 Oct. 1852); Hinrichs, Verz. Juli–Dec. **1852**: 151; Wikström, Års-berätt. **1851**: 111 (1855); Leipz. Rep. **11**, I: 120 (1853).
Fasc. 14.	text pp. 465–741, Conspectus pp. 1–16	1853 (probably June)	Allg. Bibl. **1853**: 229 (14 July 1853); Bot. Zeit. **11**: 630 (Sept. 1853); Hinrichs, Verz. Juli–Dec. **1853**: 173; Leipz. Rep. **11**, IV: 52 (1853).

Ledebour's *Icones Plantarum novarum vel imperfecte cognitarum Floram Rossicam, imprimis Altaicam, illustrantes* (5 vols., folio, with colored plates; Riga etc.) was also published in parts. A copy in the Lindley Library with the original wrappers preserved supplies the following data:

Vol. 1	fasc. 1,	tt.	1–50	} 1829	
" 1	" 2,	"	51–100		
" 2	" 1,	"	101–150	} 1830	
" 2	" 2,	"	151–200		
" 3	" 1,	"	201–250	— 1831	
" 3	" 2,	"	251–300	— 1832	
" 4	" 1,	"	301–350	} 1833	
" 4	" 2,	"	351–400		
" 5	" 1,	"	401–450	} 1834	
" 5	" 2,	"	451–500		

Ledebour's *Flora Altaica* (4 vols. and index, octavo: Berlin) provides detailed text to the *Icones*. This work, which was written in collaboration with his one-time pupils, Carl Anton MEYER (1795–1855) and Alexander von BUNGE (1803–1890), is based on an expedition to the Little (or Siberian) Altai region of Central Asia made by the three in 1826. Their travels extended from Dorpat to Barnaul, Zmeyeva (Schlangenberg), Krasnoyarsk, the source of the river Charysh (Tscharysh) etc., the Riddersk mine and about 120 miles eastward over the Altai mountains. For a detailed account, see their *Reise durch das Altai-Gebirge und die Soongorische Kirgisen-Steppe* (2 vols., octavo, and atlas of plates, quarto; Berlin, 1829–30). The *Flora Altaica* was not published in parts but a whole volume at a time, as follows:

Vol. 1, pp. xxiv	+ 440	... 1829	(probably second half)
" 2, pp. xvi	+ 464	... 1830	" " "
" 3, pp. viii	+ 368	... 1831	" " "
" 4, pp. xiv	+ 336	... 1833	" " "
" Index, pp. xcvi		 1833	(thus dated but probably 1834, cf. Hinrichs, Verz. Juli–Dec. **1834**: 121)

Ledebour was born in Pomerania at Greifswald in 1786 (fide Flora **34**: 416. 1851) or at Stralsund on 8th July 1786 (fide Pritzel, who is more likely to be correct). In his nineteenth year he was appointed associate professor ("ausserordentlicher Professor") of Botany and

director of the botanic garden at Greifswald. From here in 1810 or 1811, after seeking information about Russia from Pallas, who was then living in Berlin, Ledebour moved to Dorpat as professor of botany, mineralogy, and zoology; much of the next twenty-five years he devoted to the botanical exploration of Russia from the Baltic to the Black Sea and east to the Altai mountains. To prepare the better his *Flora Rossica* he retired from Dorpat in 1836, his former pupil Bunge succeeding him as professor, and returned to Germany, living first at Heidelberg, then at Munich, where he died on 4th July 1851, having completed the text a few months before his death.

P. S. Pallas, *Flora Rossica seu Stirpium Imperii Rossici per Europam et Asiam indigenarum Descriptiones et Icones,* Vol. 1 pars 1 consisting of pp. viii + 80, tt. 1–8, 8B, 9–50 (1784); pars 2 consisting of pp. 114, tt. 50 (1788); extra plates 1–25 (1831); cf. B. D. Jackson in Jour. Bot. **38**: 189 (1900).

Unfortunately both parts lack indices; the following are the genera (most of them nowadays divided into smaller genera) included:

Acer 1: 8, Amygdalus 1: 12, Andromeda 2: 53, Arbutus 2: 48, Atragene 2: 69, Azalea 2: 51, **Berberis** 2: 41, Betula 1: 60, Boletus 1: 3, Buxus 2: 17, **Carpinus** 2: 6, Celtis 2: 19, Colutea 2: 88, Corispermum 2: 112, Cornus 2: *22*, Crataegus 1: 24, Cupressus 2: 11, Cynoglossum 2: 96, Cytisus 1: 73, **Daphne** 1: 53, Diospyros 2: 20, **Elaeagnus** (Eleagrus) 1: 10, Empetrum 2: 49, Ephedra 2: 87, Erica 2: 59, **Fagus** 2: 5, Ficus 2: 44, Fraxinus 2: 7, **Gentiana** 2: 101, **Hedera** 2: 68, Hippophae 2: 43, **Ilex** 2: 18, **Jasminum** 2: 33, Juglans 2: 2, Juniperus 2: 12, **Laurus** 2: 18, Ledum 2: 50, Ligustrum 2: 32, Lonicera 1: 55, Lycium 1: 78, **Mespilus** 1: 29, Morus 2: 9, Myrica 2: 90, **Nitraria** 1: 79, **Olea** 2: 19, **Paeonia** 2: 92, Pallasia 2: 70, Periploca 2: 68, Philadelphus 2: 59, Pinus 1: 1, Pistacia 2: 21, Platanus 2: 1, Prunus 1: 15, Punica 2: 67, Pyrus 1: 20, **Quercus** 2: 3, **Rhamnus** 2: 23, Rhododendron 1: 43, Rhus 2: 38, Ribes 2: 34, Robinia 1: 68, Rosa 2: 60, Ruscus 2: 89, **Salix** 2: 74, Sambucus 2: 28, Sorbus 1: 28, Spiraea 1: 32, Staphylea 2: 32, Swertia 2: 98, **Tamarix** 2: 72, Taxus 2: 17, Tilia 2: 8, **Ulmus** 1: 75, **Vaccinium** 2: 45, Viburnum 2: 30, Viscum 2: 91, Vitex 2: 44, Vitis 2: 40.

According to the English traveler Edward Daniel Clarke (1769–1822), who lodged with Pallas at Simferopol (Achmedchid) in the Crimea for two months in 1800, the drawings for the last two volumes were then all finished and the text needed little addition, but owing to the tyrannical rule of the mad Tzar Paul, they could not be published in Russia. The plates for the first part of vol. 2 had been printed by March, 1800, but the descriptive matter had not then arrived at Petrograd from Germany. Clarke says that the Russian authorities confiscated the proof-sheets sent to Pallas from Leipzig. Hence the extremely rare 25 extra plates listed by Jackson are all of vol. 2 that

saw the light; they are without text. See E. D. Clarke, *Travels* **1**: 458 (1810) and W. Otter, *Life and Remains of Edward Daniel Clarke*, **2**: 9, 59, 65, 87 (1825).

An English life of Pallas is contained in the volume on dogs by Charles Hamilton Smith in William Jardine's *Naturalist's Library* **9**: 17–76 (1839).

LINDLEY LIBRARY,
ROYAL HORTICULTURAL SOCIETY,
LONDON, ENGLAND.

STUDIES OF PAPUASIAN PLANTS, II*

A. C. Smith

MONIMIACEAE

In studying the Monimiaceae of the area under consideration, the basic works of Perkins and Gilg (Pflanzenr. 4 (IV. **101**). 1901) and Perkins (Pflanzenr. 49 (IV. **101**. Nachtr.). 1911; Bot. Jahrb. **52**: 191–218. 1915) are of inestimable importance. By far the greater part of the Papuasian material available to these workers was collected in Northeastern New Guinea, and hence it is not surprising that the collections of the Archbold Expeditions, from British and Netherlands New Guinea, contain a considerable percentage of novelties. Many of the present specimens are in fruiting condition, particularly in the genus *Kibara;* however, this genus is readily recognizable in fruit, and since foliage and fruit characters appear the most important in specific identification, I have ventured to describe as new three species of *Kibara* without flowers. The generic limits recognized by Perkins are accepted in this treatment, and the sequence established by her is followed. I have been privileged to examine the material deposited in the herbarium of the New York Botanical Garden (NY) as well as that in the herbarium of the Arnold Arboretum (A); the place of deposit is shown by the parenthetical letters, in the absence of which the specimen is to be found only at the Arnold Arboretum. Type fragments and original drawings of many of Perkins' species in the Gray Herbarium have greatly facilitated my work.

Hedycarya Forst.

Hedycarya solomonensis Hemsl. Kew Bull. **1895**: 137. 1895; Perk. Pflanzenr. 49 (IV. **101**. Nachtr.): 6. 1911.

Solomon Islands: Bougainville: Koniguru, Buin, alt. 800–950 m., *Kajewski 1995, 2058.* Guadalcanal: Berandie River, sea-level, *Kajewski 2384;* Ululolo, Tutuve Mt., alt. 1200 m., *Kajewski 2561.*

The species, apparently previously known only from the type collection from San Cristoval, is common in rain-forest over a wide altitudinal range, according to Kajewski. He reports it as a tree up to

*(Botanical Results of the Richard Archbold Expeditions) See Jour. Arnold Arb. 22: 60–80. 1941.

20 m. high, known by the local names of *Kokobila* (Bougainville) and *Maroi* or *Undie* (Guadalcanal); the natives make a poultice from the leaves and apply it to sores. The ripe fruits are black, on a yellow receptacle.

Another specimen from Bougainville which may also represent the species is *Kajewski 1887* (Kugumaru, Buin, alt. 150 m.; tree to 12 m. high, in rain-forest; native name: *Cher-rau*). This plant has leaf-blades up to 30 cm. long and 11 cm. broad and is more robust throughout than those cited above. It may represent an undescribed species, but the variation within species of *Hedycarya* is unusually pronounced; additional material is desired before the extreme limits of *H. solomonensis* are known.

LEVIERIA Becc.

Levieria nitens Perk. in Perk. & Gilg, Pflanzenr. 4 (IV. **101**): 21. 1901; Pflanzenr. 49 (IV. **101**. Nachtr.): 7. *f. 3, R, S.* 1911; Bot. Jahrb. **52**: 196. 1915; S. Moore, Jour. Bot. **61**: Suppl. 41. 1923.

BRITISH NEW GUINEA: Central Division, Dieni, Ononge Road, alt. 500 m., *Brass 3805* (A, NY) (erect tree 20 m. tall, common in rain-forest, the bark brittle, dark brown, with a few scattered lenticels, the wood hard, brown, with numerous fine rays; leaves smooth, paler beneath; receptacle fleshy, yellow, the fruits orange-yellow). NETHERLANDS NEW GUINEA: 4 km. southwest of Bernhard Camp, Idenburg River, alt. 900 m., *Brass 13086* (tree 7–8 m. high, common in mossy forest substage layer; receptacle orange, the fruits red).

The species has previously been reported only from two collections by Forbes from Sogere. No. *13086* differs from the other in having its secondary nerves slightly more spreading, but it seems to fall into a reasonable concept of the species.

Levieria squarrosa Perk. Bot. Jahrb. **52**: 196. 1915.

NETHERLANDS NEW GUINEA: 15 km. southwest of Bernhard Camp, Idenburg River, alt. 1800 m., *Brass 12253* (tree 3–4 m. high with weak slender branches, occasional in mossy forest seral growths; receptacle yellow, the fruits black); 18 km. southwest of Bernhard Camp, alt. 2150 m., *Brass 12493* (weak slender tree 3–6 m. high, very abundant in young seral growths of mossy forest; receptacle fleshy, orange, the fruits reddish black).

The cited specimens agree well with the description of *L. squarrosa*, otherwise reported only from Ledermann's collections in the neighboring Sepik River region of Northeastern New Guinea. A comparison with type material should be made before the Brass specimens are definitely taken as this species.

Levieria parvifolia sp. nov.

Frutex vel arbor parva 2–3 m. alta ubique sub anthesi glabra, ramulis gracilibus subteretibus apicem versus stramineis demum cinereis; foliis oppositis vel suboppositis, petiolis 4–7 mm. longis, laminis tenuiter coriaceis vel chartaceis siccitate fusco-olivaceis elliptico-oblongis, 3–5 cm. longis, 1–2 cm. latis, basi acutis et in petiolum decurrentibus, apice obtusis vel subacutis et inconspicue calloso-apiculatis, margine dentibus paucis (utrinsecus 2 vel 3) calloso-apiculatis ornatis et leviter recurvatis, costa supra valde prominula subtus subprominente, nervis secundariis utrinsecus 5–9 brevibus patentibus supra subimmersis vel leviter prominulis subtus manifeste elevatis, venulis inconspicuis subtus leviter prominulis; inflorescentiis ♀ paucis axillaribus plerumque unifloris, pedunculo gracili interdum ad 2 cm. longo bracteis 2- vel 3-jugis oppositis oblongis subacutis ad 1 mm. longis saepe ornato interdum nullo, pedicello gracili 6–13 mm. longo; floribus late cupuliformibus sub anthesi 5–6 mm. diametro, receptaculo complanato, tepalis 4 incurvatis tenuiter coriaceis late deltoideis subacutis, circiter 2 mm. longis et 4 mm. latis; carpellis 35–40 congestis 1.5–2 mm. longis leviter angulatis in stylum brevem subacutum desinentibus; receptaculo sub fructu coriaceo ad 8 mm. diametro, drupis maturis 1–5 ovoideis subacutis ad 9 mm. longis et 6 mm. latis.

British New Guinea: Central Division, Murray Pass, Wharton Range, alt. 2840 m., *Brass 4630* (A, type, NY), July 28, 1933 (forest substage tree or bush, loosely branched, 2–3 m. high; leaves shining, paler beneath; fruit smooth, yellow).

Levieria parvifolia appears to be closely related to *L. squarrosa* Perk., differing in its smaller leaf-blades with fewer serrations and the apex acute or obtuse rather than obviously acuminate, and in the presence of obvious tepals on the pistillate flowers.

Idenburgia Gibbs

Idenburgia elaeocarpoides Gilg & Schlecht. Bot. Jahrb. **58**: 247. 1923.

Northeastern New Guinea: Morobe District, Yunzaing, alt. 1350 m., *Clemens 3978* (tree, on forest hill, the trunk 30 cm. diam.; fruit green); Ogeramnang, alt. 1800 m., *Clemens 5122*. Netherlands New Guinea: 18 km. southwest of Bernhard Camp, Idenburg River, alt. 2150 m., *Brass 12661* (occasional subsidiary tree about 20 m. high, in mossy forest; leaves stiff, concave, very pale beneath; flowers white, fleshy; fruit red); Bele River, 18 km. northeast of Lake Habbema, alt. 2200 m., *Brass 11078* (tree 14 m. high, in old secondary forest; leaves very pale beneath; fruit red); 9 km. northeast of Lake Habbema, alt. 2740 m.,

Brass & Versteegh 10472 (tree 15 m. high, rare in mossy forest, the trunk 27 cm. diam., the crown not wide-spreading; immature flowers and fruits green; bark 5 mm. thick, black, fissured, rough; wood orange-colored).

The differences between *I. pachyphylla* and *I. elaeocarpoides*, the two new species proposed by Gilg and Schlechter in their discussion of *Idenburgia* (Bot. Jahrb. **58**: 244–248. *f. 1, 2.* 1923), do not seem very pronounced. Our material agrees better with the description of *I. elaeocarpoides*, being glabrous throughout, but it is quite possible that the two names will prove conspecific. Our specimens are all in fruit, *Brass 12661* bearing flowers as well. The specimens available to Gilg and Schlechter apparently had uniformly 1-seeded fruits, but those cited above have about half of the fruits 2-seeded; the development to maturity of the second ovule appears to take place very frequently.

The species has previously been reported only from Ledermann's original collections in Northeastern New Guinea.

Idenburgia pauciflora sp. nov.

Arbor ad 3.5 m. alta, ramulis copiosis gracilibus subteretibus apicem versus densissime et arcte brunneo-tomentellis demum glabratis et cinereis; foliis oppositis vel suboppositis vel interdum ad apices ramulorum verticillatis, petiolis gracilibus leviter canaliculatis ut ramulis tomentellis 6–11 mm. longis, laminis papyraceis vel chartaceis obovato-ellipticis, 5–7 cm. longis, 1.8–2.8 cm. latis, basi acutis vel subattenuatis, apice abrupte cuspidatis (apice ipso ad 6 mm. longo calloso), margine inconspicue nigro-calloso-serrulatis (dentibus 4–8 per centimetrum), supra siccitate brunneis et pilis debilibus pallidis paucis exceptis glabris, subtus pallidioribus et praecipue ad nervos et venulas pilis crispulis stramineis ad 0.4 mm. longis tomentellis, costa supra impressa subtus elevata, nervis secundariis utrinsecus 5–8 brevibus subrectis anastomosantibus supra acute impressis subtus prominulis, venulis supra immersis subtus paullo prominulis; inflorescentiis solitariis terminalibus paucifloris breviter racemosis sub anthesi 6–15 mm. longis, pedunculo brevi (ad 3 mm. longo) et rhachi teretibus 1–1.5 mm. diametro dense stramineo-tomentellis (pilis circiter 0.4 mm. longis), rhachi cicatricibus florum delapsorum saepe congestis conspicue ornata; bracteis submembranaceis ovato-oblongis obtusis, 4–4.5 mm. longis, circiter 2.5 mm. latis, extus pilis ad 0.7 mm. longis dense tomentellis, intus glabris, mox deciduis; floribus 6–10 per inflorescentiam mox caducis sub anthesi plerumque paucioribus, pedicellis crassis brevissimis (circiter 0.8 mm. longis) ut rhachi tomentellis; tepalis 4 membranaceis obovato-

orbicularibus mox caducis, circiter 2.5 mm. diametro, margine integris vel leviter undulatis, exterioribus ut bracteis extus conspicue tomentellis, interioribus utrinque glabris; staminibus circiter 8 glabris, filamentis carnosis complanatis circiter 0.2 mm. longis, antheris oblongis falcato-incurvatis 1.7–2 mm. longis, apice obtusis; gynaecio oblongo sub anthesi circiter 1.3 mm. longo et 1 mm. diametro, ovario pilis circiter 0.3 mm. longis dense stramineo-tomentello, stigmate sessili glabro pulvinato obscure lobato.

NORTHEASTERN NEW GUINEA: Morobe District, Yunzaing, alt. about 1400 m., *Clemens 3828* (TYPE), Aug. 11, 1936 (tree about 3.5 m. high, along forest trail; flowers cream-colored).

Idenburgia pauciflora is very distinct from the four species of the genus thus far known, being characterized by the small size of all its parts (leaves, inflorescences, and flowers) and the conspicuous tomentum of its branchlets, petioles, leaf-blades, and inflorescences. The tomentellous ovary appears to be especially noteworthy. In leaf-shape and size, the new species is perhaps most suggestive of *I. novo-guineensis* Gibbs, but characters of pubescence and inflorescence-size readily separate the two species.

STEGANTHERA Perk.

Steganthera Schumanniana Perk. Bot. Jahrb. **25:** 565. 1898; Perk. & Gilg, Pflanzenr. 4 (IV. **101**): 53. 1901; Kaneh. & Hatus. Bot. Mag. Tokyo **52:** 355. 1938.

NORTHEASTERN NEW GUINEA: Morobe District, Ogeramnang, alt. about 1600 m., *Clemens 4840*.

The cited specimen agrees well with the two previously known, both from the same general region, but often has the leaf-blades with a few inconspicuous callose-apiculate teeth on each side.

Steganthera ilicifolia sp. nov.

Frutex monoecus ad 2.5 m. altus, ramulis gracilibus subteretibus ad nodos complanatis juventute purpurascentibus et inconspicue cinereo-strigillosis mox glabris et stramineis;* foliis oppositis, petiolis rugosis canaliculatis mox glabris 4–7 mm. longis, laminis chartaceis ellipticoblongis, 4.5–8.5 cm. longis, 1.5–4.5 cm. latis, basi obtusis, apice acuminatis (acumine 5–10 mm. longo calloso-apiculato), margine dentibus deltoideis conspicuis calloso-apiculatis utrinsecus 3–5 remote serratis, utrinque glabris, siccitate supra viridi-olivaceis subtus fuscis, costa supra valde elevata subtus prominente, nervis secundariis utrinsecus 4–6 arcuatis anastomosantibus utrinque conspicue elevatis, venulis copiose reticulatis utrinque valde prominulis; inflorescentiis axillaribus pauci-

floris breviter paniculatis vel racemosis sub anthesi ad 1.5 cm. longis, ubique pilis fusco-cinereis 0.2–0.3 mm. longis inconspicue adpresso-strigosis demum glabris, bracteis oblongis 1–2 mm. longis caducis, rhachi pedicellisque gracilibus, pedicellis 2–4 mm. longis, bracteolis 2 apicem pedicelli versus insertis lineari-oblongis obtusis ad 1.5 mm. longis vel nullis; floribus ♂ subglobosis 2–2.5 mm. diametro, receptaculo urceolato carnoso circiter 0.5 mm. crasso intus glabro, tepalis 4 minutis inflexis anguste imbricatis deltoideis obtusis, 0.3–0.5 mm. longis, 0.5–1 mm. latis; staminibus 4 oblongis carnosis, circiter 0.8 mm. latis, exterioribus circiter 1.2 mm. longis, interioribus paullo brevioribus, filamentis brevibus glabris, antheris apice rotundatis; floribus ♀ ut ♂ similibus vel paullo majoribus, apice mucronulatis, receptaculo intus obscure sericeo, tepalis subnullis; carpellis circiter 10 congestis parce et demum densiore pilosis 1.2–1.5 mm. longis, ovario ovoideo, stylo subulato; inflorescentiis sub fructu ad 3 cm. longis, receptaculo plerumque unico ad 6 mm. diametro, drupis maturis ut videtur 2–5 ovoideis ad 10 mm. longis et 8 mm. latis, breviter stipitatis, demum glabris, apice saepe apiculatis.

British New Guinea: Central Division, Murray Pass, Wharton Range, alt. 2840 m., *Brass 4752* (A, type, NY), Aug. 8, 1933 (straggling bush up to 2.5 m. high, very common, forming small thickets in forest fringes and isolated forest patches; receptacle yellow, fleshy).

This well-marked species appears most closely related to *S. Schumanniana* Perk., from which it obviously differs in its smaller conspicuously toothed leaf-blades with strongly prominulous venation, its more compact inflorescences, and its glabrous stamens.

Steganthera elliptica sp. nov.

Arbor parva ad 1.5 m. alta ubique praeter inflorescentiam parcissime cinereo-strigosam glabra, ramulis gracilibus subteretibus ad nodos complanatis mox cinereis; foliis oppositis, petiolis gracilibus rugosis 5–13 mm. longis, laminis chartaceis ellipticis, 5–9.5 cm. longis, 3–5 cm. latis, basi obtusis et in petiolum decurrentibus, apice obtusis vel breviter cuspidatis (apice ipso calloso-apiculato), margine dentibus minutis calloso-apiculatis utrinsecus 3–5 remote serratis, siccitate utrinque fusco-viridibus, costa supra conspicue elevata subtus prominente, nervis secundariis utrinsecus 4–6 leviter arcuatis marginem versus anastomosantibus supra subplanis subtus prominulis, venulis supra immersis subtus leviter prominulis; inflorescentiis axillaribus plerumque plurifloris paniculatis sub anthesi 3–8 cm. longis mox glabris, bracteis oblongis obtusis ad 1 mm. longis manifeste strigosis, pedicellis gracilibus ad 6 mm. longis saepe minute bibracteolatis; floribus ♀ ellipsoideis circiter 3 mm. longis et

2.5 mm. latis apice piloso-apiculatis, receptaculo carnoso urceolato intus dense brunneo-strigoso, tepalis subnullis, ore minuto; carpellis circiter 14 glabris 1.2–1.4 mm. longis, ovario oblongo-ellipsoideo, stylo minuto subacuto; receptaculis sub fructu plerumque (1–)2–5 per inflorescentiam coriaceis ad 1 cm. diametro, drupis maturis ut videtur 2–6 ovoideis ad 10 mm. longis et 6 mm. latis sessilibus subacutis.

Northeastern New Guinea: Morobe District, Ogeramnang, alt. about 1800 m., *Clemens 5105* (type), Jan. 23, 1937 (small tree 4 ft. high, in woods near water-supply; receptacle yellow, the fruits red); Mount Kudose Seggele, Ogeramnang, alt. 1850–2150 m., *Clemens 4934* (small tree 4 ft. high, in forest; receptacle yellow, the fruits red).

Steganthera elliptica is of the relationship of *S. oblongiflora* Perk. and *S. atepala* Perk., differing from both in its more completely glabrous habit and its elliptic and proportionately broader leaf-blades, which are sparsely serrate and obtuse or merely cuspidate rather than long-acuminate at apex.

Steganthera insignis Perk. Pflanzenr. 49 (IV. **101**. Nachtr.): 24. 1911; Bot. Jahrb. **52**: 202. 1915; Diels in White, Jour. Arnold Arb. **10**: 214. 1929.

Netherlands New Guinea: 6 km. southwest of Bernhard Camp, Idenburg River, alt. 1250 m., *Brass 13029* (small tree 2 m. high, in rain-forest undergrowth; receptacle orange-yellow, the fruits purple-black); 4 km. southwest of Bernhard Camp, alt. 850 m., *Brass 13464* (undergrowth tree 3 m. high, in rain-forest of river flood-plain; nodes of branches myrmecophilous; receptacle red, the fruits reddish brown).

This curious plant has previously been reported only from Northeastern and British New Guinea. The species was confused with *Anthobembix hospitans* (Becc.) Perk. by Perkins in her earlier treatments (Perk. & Gilg, Pflanzenr. 4 (IV. **101**): 55. 1901; in K. Schum. & Lauterb. Fl. Deutsch. Schutzg. Südsee 330. 1901). Its staminate flowers are turbinate or essentially globose, as is usual for *Steganthera*, but its pistillate flowers are somewhat patelliform, with the perianth conspicuously expanded laterally into a circular flange. This type of pistillate perianth is not otherwise found in *Steganthera* but is essentially similar to that of *Anthobembix*. The present species, therefore, seems to form a connecting link between the genera and may well be sought in *Anthobembix*. Our specimens agree well with *Brass 1331* from British New Guinea (cited by Diels), but that specimen has only pistillate flowers.

ANTHOBEMBIX Perk.

Anthobembix myrtifolia sp. nov.

Arbor gracilis 3–4 m. alta, ramulis gracilibus subteretibus purpurascentibus juventute cinereo-adpresso-strigosis mox glabris; foliis oppositis, petiolis gracilibus canaliculatis 4–6 mm. longis ut ramulis strigosis mox glabris, laminis tenuiter coriaceis oblongo-ellipticis, 3–6 cm. longis, 1–3 cm. latis, basi acutis et in petiolum decurrentibus, apice acutis vel breviter cuspidatis et calloso-apiculatis, margine integris et leviter incrassatis, utrinque glabris et siccitate fusco-viridibus, costa utrinque valde elevata, nervis secundariis utrinsecus 3–6 anastomosantibus, cum venulis copiose reticulatis utrinque valde prominulis; inflorescentiis ♂ axillaribus 1–3 cm. longis 2- vel saepe 1-floris ubique dense cinereo-adpresso-strigillosis, bracteis elongato-deltoideis ad 2 mm. longis mox delapsis, pedicellis gracilibus ad 15 mm. longis apicem versus interdum bibracteolatis (bracteolis lanceolato-oblongis acutis circiter 1.5 mm. longis); floribus mox glabris plus minusve patelliformibus circiter 2 mm. altis et 5 mm. diametro, receptaculo carnoso margines versus conspicue complanato intus obscure sericeo, tepalis minutis ut videtur 4 deltoideis acutis anguste imbricatis; staminibus 4 oblongis circiter 1 mm. latis, majoribus 1 mm. minoribus 0.7 mm. longis, filamentis carnosis dense strigoso-sericeis, antheris apice rotundatis per rimas introrsas horizontales dehiscentibus; inflorescentiis ♀ ut ♂ similibus sed plerumque unifloris; receptaculo turbinato apicem versus lateraliter paullo expanso, sub anthesi 2–2.5 mm. longo et circiter 3 mm. diametro, intus dense strigoso, tepalis ut videtur subnullis; carpellis circiter 6, 1.3–1.5 mm. longis, ovario ellipsoideo dense strigoso, stylo brevi subulato acuto glabro; pedicello sub fructu paullo incrassato ad 18 mm. longo, receptaculo coriaceo circiter 4 mm. diametro, drupis maturis paucis elliptico-ovoideis ad 13 mm. longis et 9 mm. latis, breviter stipitatis, apice rotundatis, extus conspicue rugosis.

NETHERLANDS NEW GUINEA: 18 km. southwest of Bernhard Camp, Idenburg River, alt. 2150 m., *Brass 12498* (slender tree 3–4 m. high, frequent in mossy forest seral growths), *12672* (TYPE), Feb. 1939 (tree 3 m. high, in bamboo undergrowth of mossy forest).

The type bears staminate flowers and a single detached drupe, while no. *12498* bears pistillate flowers and fruiting receptacles. The new species is peculiar in *Anthobembix* in the fact that, although its staminate flowers have the receptacle greatly expanded as is usual for the genus, the receptacle of the pistillate flowers is merely slightly expanded and is more suggestive of the genus *Steganthera*. *Anthobembix myrtifolia* is

also at once distinguished from the members of either genus by its small stiff leaves; *A. parvifolia* Perk. is perhaps its closest ally.

Anthobembix Brassii sp. nov.

Frutex subscandens, ramulis subteretibus juventute pilis crispis simplicibus 0.3–1 mm. longis densissime pallide brunneo-tomentosis demum glabris cinereis; foliis oppositis vel suboppositis, petiolis rugulosis ut ramulis decidue tomentellis mox glabris 10–22 mm. longis, laminis chartaceis elliptico-oblongis, 8–13 cm. longis, 3.5–6.5 cm. latis, basi late obtusis vel rotundatis, apice breviter cuspidatis, margine integris vel interdum utrinsecus dentibus ad 5 minutis calloso-apiculatis remote et obscure serratis, siccitate utrinque fusco-viridibus vel subtus brunneis, supra glabris, subtus tomentum crispulum cinereum evanescentem (pilis ad 0.7 mm. longis) gerentibus mox glabris, costa supra valde elevata subtus prominente, nervis secundariis utrinsecus 6–9 erecto-patentibus conspicue anastomosantibus supra valde prominulis subtus subprominentibus, venulis copiose reticulatis utrinque prominulis; inflorescentiis axillaribus vel subterminalibus cymosis vel paniculato-cymosis pauciflоris (plerumque 3- interdum ad 9-floris) ad 4 cm. longis, ubique praeter florum superficies pilis fusco-stramineis 0.5–0.7 mm. longis dense tomentellis, pedunculo ad 2 cm. longo, bracteis oblongis 1.5–2.5 mm. longis caducis, pedicellis ad 7 mm. longis infra medium et apicem bracteolam unicam lineari-oblongam obtusam ad 2 mm. longam caducam gerentibus; floribus ♂ plerumque ad apices inflorescentiae ternatis supra glabris et nigrescentibus patelliformibus valde complanatis, sub anthesi ad 4 mm. altis et 9 mm. diametro, receptaculo carnoso ad margines conspicue expanso intus stramineo-strigoso, tepalis minutis vel subnullis; staminibus 4 carnosis oblongis circiter 1.2 cm. latis, majoribus sub anthesi 1.5 mm. minoribus 1.2 mm. longis, filamentis brevibus basi pilis ad 1 mm. longis conspicue brunneo-strigosis, antheris apice rotundatis per rimas introrsas horizontales dehiscentibus; floribus ♀ ut ♂ similibus, carpellis 10–14 sub anthesi 2–2.5 mm. longis, ovario oblongo-ellipsoideo pilis ad 1 mm. longis dense brunneo-setoso, stylo brevi subacuto glabro; pedunculis pedicellisque sub fructu incrassatis demum subglabris, receptaculo coriaceo saepe solitario ad 8 mm. diametro supra persistenter strigoso, drupis maturis saepe numerosis (2–10) coriaceis sessilibus ellipsoideis ad 12 mm. longis et 10 mm. latis, apice abrupte mucronatis, demum glabris, extus conspicue rugosis.

Netherlands New Guinea: 9 km. northeast of Lake Habbema, alt. 2800 m., *Brass 10261* (type), Oct. 1938 (large subscandent shrub, occasional in undergrowth of primary forest).

Anthobembix Brassii is readily distinguished by the evanescent crisp pale tomentum of its branchlets and foliage, its compact and densely tomentellous inflorescences, and its flattened flowers which are glabrous above. Probably more closely related to *A. oligantha* Perk. than to other described species, it is sharply distinct on the basis of the mentioned characters.

KIBARA Endl.

Kibara laurifolia sp. nov.

Arbor ad 6 m. alta sub fructu ubique glabra, ramulis fusco-cinereis subteretibus apicem versus 2.5–4 mm. diametro ad nodos incrassato-complanatis; foliis oppositis vel suboppositis, petiolis rugulosis crassis (2–4 mm. diametro) profunde canaliculatis 3–10 mm. longis, laminis coriaceis siccitate pallide olivaceis late ellipticis, 9–15 cm. longis, 4.5–8.5 cm. latis, basi obtusis, apice breviter cuspidatis vel subacutis, margine integris et conspicue anguste recurvatis, costa supra elevata et saepe striata subtus prominente, nervis secondariis utrinsecus 6–8 adscendentibus subrectis vel margines versus leviter arcuatis supra prominulis subtus acute elevatis, venulis reticulatis utrinque prominulis vel supra subimmersis; inflorescentiis sub fructu axillaribus vel subterminalibus 3–8 cm. longis, pedunculo ad 3 cm. longo pedicellisque paullo complanatis, pedicellis 10–27 mm. longis apicem versus incrassatis, receptaculis 2–6 per inflorescentiam vel interdum solitariis coriaceis 5–10 mm. diametro, drupis maturis pluribus coriaceis oblongo-ovoideis, ad 16 mm. longis et 10 mm. latis, stipitibus 2–3 mm. longis et crassis articulatis ornatis, apice inaequaliter apiculatis, basi obtusis vel rotundatis, extus sublevibus.

NETHERLANDS NEW GUINEA: Bele River, 18 km. northeast of Lake Habbema, alt. 2200 m., *Brass 11218* (TYPE), Nov. 1938 (tree 6 m. high, common in secondary forest, the fruits unripe).

Kibara laurifolia is a species with glabrous coriaceous leaf-blades, but it does not seem closely related to any of the species in this section of Perkins' key (Bot. Jahrb. **52**: 208. 1915). Although flowers are not available, the new species seems more closely allied to *K. monticola* Perk., from which it differs in its shorter and proportionately broader leaf-blades with acute or cuspidate rather than acuminate apices, more ascending secondary nerves, and venation more obvious on the upper leaf-surface.

Kibara Archboldiana sp. nov.

Frutex vel arbor parva ad 3 m. alta, ramulis stramineis gracilibus subteretibus glabris infra nodos conspicue incrassato-clavatis pertusis intus concavis formicas hospitantibus; foliis oppositis, petiolis rugulosis

incrassatis (2–4 mm. diametro) 5–25 mm. longis, laminis chartaceis vel papyraceis oblongo-ellipticis, 15–36 cm. longis, 6–15 cm. latis, basi rotundatis vel late obtusis, apice conspicue et abrupte acuminatis (acumine gracili 1–2 cm. longo obtuso), margine integris et anguste recurvatis, utrinque olivaceis et glabris vel subtus juventute sub lente minutissime et decidue puberulis, costa supra elevata et saepe striata subtus prominente, nervis secundariis utrinsecus 6–10 arcuato-patentibus conspicue anastomosantibus supra valde elevatis subtus prominentibus, venulis copiose reticulatis utrinque valde prominulis; inflorescentiis subfasciculatis vel contracto-racemosis paucifloris sub anthesi quam petiolis multo brevioribus ad 8 mm. longis, ubique minute cinereo-puberulis, pedunculo crasso brevi, bracteis inconspicuis papyraceis suborbicularibus ad 0.4 mm. longis, pedicellis gracilibus sub anthesi 3–6 mm. longis apicem versus minute bibracteolatis; floribus ♂ subglobosis 2–4 mm. diametro, receptaculo crasse carnoso (ad 1 mm. crasso) valde cupuliformi; tepalis 6 minutis ovatis rotundatis, 4 per paria cruciatim oppositis anguste imbricatis, 2 exterioribus duplicatis; staminibus 6, 4 exterioribus 1–1.6 mm. longis, antheris subsessilibus ovoideis per rimam horizontalem semiorbicularem dehiscentibus; inflorescentiis sub fructu valde incrassatis, receptaculis 1 vel 2 coriaceis 8–12 mm. diametro, drupis maturis pluribus ovoideo-oblongis, 16–23 mm. longis, 8–10 mm. latis, breviter stipitatis (stipitibus 1–3 mm. longis superne valde incrassatis articulatis), apice inaequaliter subacutis, extus valde rugulosis.

British New Guinea: Central Division, Dieni, Ononge Road, alt. 500 m., *Brass 3938* (A, NY, type), May 2, 1933 (weak-branched bush or small tree 2–3 m. high, fairly common in rain-forest, the leaf-blades shining above; flowers yellow; receptacle bright orange, the drupes shining purple-black); Western Division, Fly River, 528-mile Camp, alt. 80 m., *Brass 6858* (sparse-foliaged tall shrub 2 m. high, in forest undergrowth on a ridge-top).

Kibara Archboldiana is a close relative of *K. formicarum* Becc., resembling it in foliage, the myrmecophytic habit, etc., but differing in having the secondary nerves of the leaf-blades raised instead of impressed above, the inflorescence more compact, the tepals smaller and inconspicuous, the stamens 6 rather than 8, and the drupes longer and proportionately narrower.

Kibara inamoena Perk. Pflanzenr. 49 (IV. 101. Nachtr.): 34. 1911; Bot. Jahrb. **52**: 211. 1915.

British New Guinea: Lake Daviumbu, Middle Fly River, *Brass 7560* (undergrowth tree 5 m. high, in rain-forest; leaves smooth and shining, the nerves prominent on both sides).

The cited specimen agrees very well with the type collection of the species in foliage, although the leaf-blades of our specimen are often faintly puberulent beneath and have the areoles of the veinlet-reticulation slightly larger. The range of variation of the species cannot be fully understood at present; it has previously been represented only by two collections from Northeastern New Guinea. The Brass specimen, in fruit, has the inflorescences to 6 cm. long, the pedicels 13–22 mm. long, the receptacle 4–10 mm. in diameter, and the drupes ovoid-ellipsoid, to 13 by 10 mm., subacute, short-stipitate.

Kibara papuana sp. nov.

Frutex vel arbor parva ad 2 m. alta ubique praeter flores glabra, ramulis gracilibus stramineis subteretibus vel apices versus complanatis; foliis oppositis vel suboppositis, petiolis gracilibus canaliculatus 3–10 mm. longis, laminis papyraceis translucentibus oblongo-ellipticis, 9–17 cm. longis, 3.5–7 cm. latis, basi obtusis et in petiolum paullo decurrentibus, apice cuspidatis (apice ipso ad 5 mm. longo obtuso), margine integris, utrinque olivaceis, costa supra subplana vel leviter elevata subtus prominente, nervis secundariis utrinsecus 6–9 arcuato-adscendentibus supra prominulis vel subplanis subtus elevatis, venulis reticulatis utrinque paullo prominulis vel supra subimmersis; inflorescentiis axillaribus vel e ramulis inter folia orientibus fasciculatis paucifloris (in specimine nostro 1- vel 2-floris), bracteis deltoideis subacutis ad 1 mm. longis, pedicellis crassis sub anthesi circiter 2 mm. longis, apice quadribracteolatis (bracteolis late deltoideis vel semiorbicularibus obtusis, inferioribus circiter 0.5 mm. longis et 1 mm. latis, superioribus circiter 1 mm. longis et 1.5 mm. latis infra tepala orientibus); floribus ♂ 2–2.5 mm. longis et diametro, receptaculo tenuiter carnoso leviter cupuliformi; tepalis 6 submembranaceis late semiorbicularibus, circiter 1 mm. longis, 1.5–2 mm. latis, apice rotundatis, luteo-glandulosis, 4 per paria cruciatim oppositis, 2 exterioribus duplicatis; staminibus 6 obovoideis circiter 0.8 mm. latis, 4 exterioribus circiter 1.2 mm. longis, 2 interioribus paullo brevioribus, filamentis gracilibus dense stramineo-sericeis, antheris late deltoideis obtusis per rimam horizontalem semiorbicularem dehiscentibus; floribus ♀ ut ♂ plus minusve similibus, receptaculo subcomplanato intus dense aureo-setuloso, tepalis paullo majoribus calyptra sub anthesi supra receptaculum circumscisse deciduis; carpellis 7 ovoideis circiter 1.5 mm. longis, ovario dense stramineo-sericeo, stylo brevi; inflorescentiis sub fructu incrassatis, receptaculis 1 vel 2 coriaceis stipitibus exceptis ad 7 mm. diametro, drupis maturis pluribus ellipsoideis, 12–18 mm. longis, 7–11 mm. latis, interdum paullo lateraliter compressis, stipitibus crassis

(ad 3 mm. diametro) 4–6 mm. longis ornatis, apice obtusis vel rotundatis, extus saepe valde tuberculato-rugosulosis.

British New Guinea: Central Division, Dieni, Ononge Road, alt. 500 m., *Brass 3798* (NY, type), Apr. 20, 1933 (shrub 2 m. high, in rain-forest understorey; leaves shining on both sides; flowers yellow; drupes black, wrinkled), *Brass 3992* (A, NY) (tall bush or small tree, in rain-forest understorey; leaves flat, smooth; drupes rugose, yellow-green, at length pale purple); Iawarere, alt. about 300 m., *Brass 668* (large weak shrub, in rain-forest; drupes yellow).

All the cited specimens bear fruits, but only the type has flowers, and these are very few, so that the above floral descriptions are based merely upon one staminate and one pistillate flower. Nevertheless, the material is sufficient to indicate that an unusual species is represented, characterized by thin entire leaf-blades of medium size for the genus, very compact and few-flowered inflorescences, short pedicels, a supplementary pair of bracteoles on the receptacle (somewhat intermediate in size and position between the pedicellary bracteoles and the tepals), and conspicuously rugulose drupes. Its alliance is apparently with *K. inamoena* Perk., a species with undulate-serrulate leaf-blades, comparatively ample inflorescences with long pedicels, and more numerous carpels.

Kibara rigidifolia sp. nov.

Arbor ad 4 m. alta sub fructu ubique glabra, ramis elongatis, ramulis stramineis crassis (apicem versus 5–7 mm. diametro) juventute conspicue angulatis; foliis suboppositis apices ramulorum versus ut videtur congestis, petiolis rugosis 2–3 mm. diametro 13–20 mm. longis, laminis tenuiter coriaceis siccitate flavovirente-olivaceis lanceolato-oblongis, 18–31 cm. longis, 4.5–7.5 cm. latis, basi attenuatis et in petiolum decurrentibus, apice conspicue calloso-apiculatis, margine leviter recurvatis interdum integris interdum dentibus utrinsecus ad 8 disperse spinulosis, costa supra leviter elevata et striata subtus prominente, nervis secundariis utrinsecus 20–27 cum aliis interspersis patentibus rectis anastomosantibus utrinque valde prominulis, venulis reticulatis utrinque paullo prominulis; inflorescentiis axillaribus sub fructu ad 3 cm. longis pauciramosis, pedunculo brevi ad 15 mm. longo, pedicellis crassis 12–15 mm. longis, receptaculis 1 vel 2 coriaceis stipitibus exceptis 6–8 mm. diametro, drupis maturis pluribus ovoideis, 12–16 mm. longis, 8–10 mm. latis, breviter stipitatis (stipitibus incrassatis 1–3 mm. longis), apice conspicue apiculatis, extus levibus vel paullo rugulosis.

British New Guinea: Lower Fly River, east bank opposite Sturt Island, *Brass 8216* (type), Oct. 1936 (tree 4 m. high, with long droop-

ing branches, in undergrowth on a moist shaded cliff-face in rain-forest, the branchlets 3-angled; leaves stiff, narrowly recurved at margins; receptacle orange, the drupes smooth, black).

Although the cited specimen lacks flowers, it obviously belongs in *Kibara* and, on the basis of foliage characters, seems certainly to be undescribed. It appears to be most closely related to *K. Ledermannii* Perk., from which it differs in its angled branchlets, proportionately narrower and often spinulose-margined leaf-blades, apparently more compact fruiting inflorescence, and less conspicuously stipitate drupes. Compared with *K. olivaeformis* Becc., another relative, *K. rigidifolia* is distinguished by its differently shaped proportionately broader drupe as well as by foliage details.

Kibara elongata sp. nov.

Arbor gracilis ad 2.5 m. alta sub fructu ubique glabra, ramulis stramineis elongatis gracilibus subteretibus vel ad nodos leviter incrassato-complanatis; foliis oppositis, petiolis crassis (3–5 mm. diametro) 14–20 mm. longis leviter canaliculatis, laminis tenuiter coriaceis siccitate viridi-olivaceis lanceolato-oblongis, 20–40 cm. longis, 6–11 cm. latis, basi attenuatis et in petiolum decurrentibus, apice longe acuminatis (acumine gracili 18–25 mm. longo calloso-subacuto), margine interdum dentibus paucis disperse et inconspicue spinulosis interdum integris, costa supra elevata et saepe inconspicue canaliculata subtus prominente, nervis secundariis utrinsecus 10–14 cum aliis interspersis patentibus rectis conspicue anastomosantibus utrinque acute elevatis, venulis reticulatis utrinque valde prominulis; inflorescentiis sub fructu axillaribus vel e ramulis inter folia orientibus pauciramosis 15–18 cm. longis, pedunculo 7–10 cm. longo pedicellisque gracilibus stramineis, pedicellis 2–4 cm. longis apicem versus incrassatis, receptaculis paucis (maturis circiter 2 per inflorescentiam) coriaceis stipitibus exceptis 7–12 mm. diametro, drupis maturis pluribus elliptico-oblongis, 22–27 mm. longis, 8–12 mm. latis, breviter stipitatis (stipitibus incrassatis 3–4 mm. longis et diametro), apice rotundatis et minute apiculatis, basi obtusis, extus rugulosis, semine siccitate nigrescente.

NETHERLANDS NEW GUINEA: 4 km. southwest of Bernhard Camp, Idenburg River, alt. 850 m., *Brass 13349* (TYPE), Mar. 1939 (slender tree 2.5 m. high, occasional in flood-plain rain-forest; receptacle orange, the drupes black).

Kibara elongata is related to the preceding new species (*K. rigidifolia*) and its allies, but is clearly distinguished by its long-acuminate leaf-blades and its elongate peduncles, pedicels, and drupes. In the latter

character it is suggestive of *K. olivaeformis* Becc., from which the acuminate and proportionately narrower leaf-blades and the elongate inflorescences distinguish it.

PALMERIA F. Muell.

Palmeria arfakiana Becc. Malesia **1**: 186. 1877; Perk. & Gilg, Pflanzenr. 4 (IV. **101**): 65, *f. 18, L, M.* 1901; Gibbs, Contr. Phyt. & Fl. Arfak Mts. 135. 1917.

NORTHEASTERN NEW GUINEA: Morobe District, Ogeramnang, alt. 1700–1800 m., *Clemens 4485* (tree 10 m. high, on forest-margin; buds green to reddish), *5169* (small tree, on forest hill; flowers gray); Tobou, alt. about 1650 m., *Clemens 6550*.

The species has previously been reported only from the Arfak Mountains in Netherlands New Guinea; our specimens precisely match a fragment of the type collection. The first two specimens cited bear staminate flowers, the last fruits. In his original publication Beccari described only foliage and pistillate flowers; Gibbs later added a description of staminate flowers, but this description does not entirely agree with my present observations, the stamens having been mentioned as 1–4 in number. The fruit has not yet been described. Below I add a description of staminate flowers and fruits based on the cited material.

Staminate inflorescences axillary, to 4 cm. long, pseudopaniculate, few-branched, densely and closely cinereous-tomentellous throughout, the peduncle, rachis, and branchlets very slender, the pedicels 2–4 mm. long, the flowers subglobose or turbinate, 2–2.5 mm. in diameter slightly before anthesis; receptacle thin-carnose or membranous, obscurely puberulent within; tepals 5, inflexed in bud, deltoid-oblong, about 1.5 mm. long, long-acuminate; anthers about 15, sessile, deltoid-oblong, 0.5–0.6 mm. long, obtuse or minutely apiculate, often obscurely puberulent distally; fruiting inflorescences lax, to 12 cm. long, the branchlets sparsely puberulent, the fruiting receptacles irregularly subglobose, to 12 mm. in diameter, glabrescent, abruptly apiculate at apex, thin, brittle, the drupes 1–5, ovoid, angled by mutual pressure, about 7 mm. long and 5 mm. broad.

Palmeria incana sp. nov.

Frutex scandens, ramulis gracilibus rectis subteretibus densissime et minutissime stellato-cinereo-puberulis ad nodos complanatis; foliis oppositis vel suboppositis, petiolis 6–9 mm. longis ut ramulis puberulis, laminis tenuiter coriaceis oblongis, 9–16 cm. longis, 3.5–6.5 cm. latis, basi rotundatis vel late obtusis, apice breviter acuminatis (acumine ad 1 cm. longo obtuso), margine integris et anguste recurvatis, supra fusco-

olivaceis subnitidis glabris (vel ad costam sparse stellato-puberulis), subtus indumento albo-cinereo arcto densissime indutis (pilis minutis stellatis multiramosis, ramulis ad 0.1 mm. longis), costa supra conspicue impressa subtus prominente, nervis secundariis utrinsecus 7–9 patentibus rectis anastomosantibus supra inconspicuis subplanis subtus valde prominulis, venulis copiose reticulatis supra immersis subtus prominulis; inflorescentiis sub fructu axillaribus anguste paniculatis 2–8 cm. longis, rhachi, ramulis brevibus et pedicellis crassis (ad 3 mm. longis) dense stellato-puberulis; receptaculis sub fructu subglobosis vel late obovoideis maturitate 10–16 mm. diametro cinereo-puberulis demum glabrescentibus, apice vestigio perianthii conspicue apiculatis, coriaceis, ad 1 mm. crassis, demum irregulariter fissis, intus pilis stramineis ad 0.8 mm. longis setosis; drupis 1–5 per receptaculum ovoideis ad 7 mm. longis et 5 mm. latis.

BRITISH NEW GUINEA: Central Division, Mafulu, alt. 1200 m., *Brass 5427* (A, TYPE, NY), Nov. 3, 1933 (large climber in lower primary forest; leaves gray beneath; fruiting receptacles red, the drupes black).

Although flowers are not available, there seems no doubt that the cited collection represents a new species of *Palmeria*, characterized by the persistent and extremely close and dense whitish tomentum of the lower surfaces of leaf-blades. *Palmeria incana* does not seem closely allied to described species, but it is perhaps of the relationship of *P. hypochrysea* Perk. and *P. hypargyrea* Perk. It differs from both in the above-mentioned pubescence, and in its somewhat larger leaf-blades which are thicker in texture.

Palmeria habbemensis sp. nov.

Frutex parvus scandens 2–3 m. altus, ramulis gracilibus elongatis purpurascentibus quadrangularibus demum subteretibus cinereo-stellato-puberulis demum glabrescentibus; foliis oppositis, petiolis gracilibus 3–8 mm. longis ut ramulis vel densiore puberulis, laminis tenuiter coriaceis oblongis, (3.5–) 4–6 cm. longis, (1.3–) 1.5–2.8 cm. latis, basi ex rotundatis subacutis, apice breviter acuminatis (acumine 3–8 mm. longo subacuto), margine integris, supra pilis stellatis flavescentibus minutis paucis obtectis mox glabris, subtus indumento stramineo arcto densissime indutis (pilis stellatis multiramosis, ramulis 0.1–0.15 mm. longis), costa supra impressa subtus valde elevata, nervis secundariis utrinsecus 4–6 patentibus anastomosantibus supra immersis vel leviter insculptis subtus valde prominulis, venulis supra immersis subtus paullo prominulis indumento obscuris; inflorescentiis ♂ axillaribus anguste paniculatis (1.5–) 2–5 cm. longis pauciramosis ubique pilis stramineis

stellatis multiramosis minutis (circiter 0.15 mm. diametro) dense obtectis, bracteis linearibus ad 3 mm. longis caducis, pedicellis gracilibus sub anthesi 4–9 mm. longis, bracteolis linearibus parvis vel nullis; floribus sub anthesi 4.5–5.5 mm. diametro, receptaculo tenuiter carnoso, tepalis 5 vel 6 subcoriaceis deltoideis acutis 1.5–2 mm. longis et latis; staminibus circiter 25, antheris sessilibus deltoideo-oblongis obtusis, circiter 0.8 mm. longis, glabris vel apicem versus obscure puberulis.

NETHERLANDS NEW GUINEA: 9 km. northeast of Lake Habbema, alt. 2800 m., Oct. 1938, *Brass 10590* (TYPE), *10591* (scrambling shrubs 2–3 m. high, common in young second growths of forest clearings; upper surface of leaves smooth and shining).

This species and the following appear to represent a small-leaved montane group in *Palmeria,* probably closely related to the preceding species (*P. incana*) of lower altitudes, but differing in obvious foliage characters. Among other described species, these two suggest *P. pulchra* Perk., another small-leaved species from high elevations in Northeastern New Guinea. However, our species apparently have the tomentum of the lower surfaces of the leaf-blades denser. In the original publication (Pflanzenr. 49 (IV. **101**. Nachtr.): 38. 1911) of *P. pulchra,* authentic material of which is not available to me, Perkins refers to "folia . . . subtus pilis stellatis minutis instructa," while in her more recent key (Bot. Jahrb. **52**: 214. 1915) she refers to the hairs as "zerstreuten." Neither of these remarks suggests the dense persistent tomentum which entirely obscures the lower leaf-surfaces of the present two new species. The inflorescences of our species are apparently more reduced than those of *P. pulchra. Palmeria habbemensis* and its relative from the Wharton Range are distinguished from each other as follows:

Leaf-blades (3.5–) 4–6 cm. long, (1.3–) 1.5–2.8 cm. broad; inflorescence (1.5–) 2–5 cm. long; stamens about 25, the anthers strictly sessile . . . . . *P. habbemensis.*

Leaf-blades 1.8–3.5 cm. long, 0.6–1.8 cm. broad; inflorescence 0.5–2 cm. long; stamens 15–20, with short but obvious filaments. . . . *P. montana.*

Palmeria montana sp. nov.

Frutex parvus multiramosus scandens 2–3 m. altus, ramulis gracilibus subteretibus cinereo-stellato-puberulis mox glabris; foliis oppositis vel suboppositis, petiolis gracilibus 1.5–4 mm. longis ut ramulis puberulis, laminis chartaceis ovatis vel ovato-oblongis, 1.8–3.5 cm. longis, 0.6–1.8 cm. latis, basi rotundatis vel late obtusis, apice acuminatis (acumine 2–7 mm. longo subacuto), margine integris et leviter recurvatis, supra glabris vel pilis stellatis cinereis minutis sparsim obtectis, subtus indumento albo-cinereo arcte densissime indutis (pilis stellatis multiramosis,

ramulis circiter 0.1 mm. longis), costa supra impressa subtus elevata, nervis secundariis utrinsecus 3–5 brevibus inconspicue anastomosantibus supra subplanis subtus paullo prominulis, venulis reticulatis utrinque immersis vel supra visibilibus; inflorescentiis ♂ axillaribus racemosis 0.5–2 cm. longis paucifloris ubique indumento cinereo denso indutis (pilis stellatis circiter 0.15 mm. diametro), bracteis oblongis ad 2 mm. longis caducis, pedicellis gracilibus sub anthesi 3–7 mm. longis bracteolam lineari-oblongam 1.5–2.5 mm. longam prope medium interdum gerentibus; floribus sub anthesi circiter 5 mm. diametro demum ad 10 mm. diametro apertis, receptaculo tenuiter carnoso intus interdum obscure puberulo, tepalis 5 submembranaceis elongato-deltoideis acutis, circiter 4 mm. longis et 2.5 mm. latis; staminibus 15–20, filamentis brevibus circiter 0.4 mm. longis tenuiter carnosis, antheris deltoideo-oblongis obtusis glabris 0.8–0.9 mm. longis; inflorescentiis ♀ ut ♂ plus minusve similibus; floribus subglobosis sub anthesi 2–2.5 mm. diametro, receptaculo carnoso 0.3–0.4 mm. crasso intus conspicue stramineo-setoso, tepalis 5 inconspicuis inflexis deltoideis circiter 0.4 mm. latis; carpellis 10–15 sub anthesi 1.5–2 mm. longis, ovario oblongo-ellipsoideo distaliter puberulo in stylum subulatum attenuato; receptaculis sub fructu irregulariter subglobosis ad 15 mm. diametro coriaceis mox glabris demum irregulariter fissis, intus pilis stramineis ad 0.7 mm. longis setosis; drupis 1–5 per receptaculum.

BRITISH NEW GUINEA: Central Division, Murray Pass, Wharton Range, alt. 2840 m., *Brass 4667* (A, TYPE, NY), July 31, 1933 (scandent much-branched slender shrub about 2 m. high, growing along forest fringing borders; leaves pale, recurved at margin, pale brown-pubescent beneath; flowers cream-colored; fruit irregularly bursting, the seeds shining reddish brown), *4751* (slender bush of somewhat scandent habit 2–3 m. high, not common in forest undergrowth; leaves gray-brown beneath; flowers cream-colored).

The type bears pistillate inflorescences and fruits, no. *4751* staminate inflorescences. The latter specimen has leaves averaging somewhat larger than those of the type collection, but in view of the similarity of the two collections in other respects it seems likely that no. *4667* was merely growing in a comparatively exposed situation.

Palmeria Fengeriana Perk. Pflanzenr. 49 (IV. **101**. Nachtr.): 39. 1911; Bot. Jahrb. **52**: 216. 1915.

BRITISH NEW GUINEA: Central Division, Mafulu, alt. 1700 m., *Brass 5360* (A, NY) (scandent shrub in mountain-crest forest; flowers cream-colored). NETHERLANDS NEW GUINEA: Bele River, 18 km.

northeast of Lake Habbema, alt. 2200 m., *Brass 11367* (large scrambling shrub on bank of river); 15 km. southwest of Bernhard Camp, Idenburg River, alt. 1800 m., *Brass 12307* (large scrambling shrub, common in open places in mossy forest).

The above-cited specimens are referred to *P. Fengeriana* with some hesitation, since they differ in certain respects from the original description. Our specimens have the leaf-blades up to 17 cm. long, the secondary nerves often as few as 5 per side, the inflorescences up to 35 cm. long and 15 cm. broad, and the staminate flowers up to 7 mm. in diameter. These appear to be characters of degree only, and I believe that the specimens fall into *P. Fengeriana* as delimited by the several citations in the second reference above, although I have seen none of this material. Among our specimens, no. *5360* has the hairs of the inflorescence and of the lower leaf-surface cinereous or whitish rather than dull yellow.

The species has previously been reported only from Northeastern New Guinea. *Palmeria paniculata* Ridley, from Netherlands New Guinea, seems closely related to *P. Fengeriana* and perhaps conspecific, although the leaves are said to be glabrous. Examination of type collections is desirable before the cited Brass material is finally placed.

Palmeria puberula sp. nov.

Frutex scandens, ramulis elongatis gracilibus purpurascentibus subteretibus parce cinereo-stellato-puberulis mox glabris; foliis oppositis, petiolis gracilibus 8–13 mm. longis ut ramulis puberulis, laminis papyraceis oblongo-ellipticis, 11–16 cm. longis, 5–8 cm. latis, basi obtusis, apice cuspidatis vel breviter acuminatis, margine integris et leviter recurvatis, supra glabris vel ad costam pilis stellatis parvis sparsim obtectis, subtus pilis stramineis stellatis multiramosis parvis (0.2–0.3 mm. diametro) paucis instructis demum glabrescentibus, costa supra leviter impressa subtus prominente, nervis secundariis utrinsecus 5–9 erecto-patentibus anastomosantibus supra minute prominulis subtus elevatis, venulis reticulatis utrinque paullo prominulis vel supra subplanis; inflorescentiis ♂ axillaribus vel e ramulis infra folia orientibus paniculatis multifloris valde ramosis, 10–15 cm. longis, 5–8 cm. latis, ubique (praecipue floribus) pilis stellatis adpressis minutis ad 0.1 mm. diametro densissime cinereo-puberulis, rhachi gracili subtereti demum glabrescente, bracteis parvis elongato-oblongis mox caducis, bracteolis ut videtur subnullis, pedicellis gracilibus sub anthesi 3–5 mm. longis; floribus late cupuliformibus sub anthesi 4–6 mm. diametro, receptaculo submembranaceo explanato, tepalis 5 membranaceis deltoideis 3–3.5 mm. longis et latis apice conspicue angustatis et acuminatis; staminibus 30–35, antheris sessilibus oblongo-deltoideis obtusis 0.8–1 mm. longis.

NETHERLANDS NEW GUINEA: 4 km. southwest of Bernhard Camp, Idenburg River, alt. 850 m., March 1939, *Brass 13463* (TYPE) (large scandent shrub, on an open river-bank in rain-forest; flowers yellow).

Palmeria puberula is characterized by its sparsely pubescent leaf-blades, its closely pale-stellate-puberulent inflorescences, and its large flowers. Related to *P. Fengeriana* Perk. and *P. paniculata* Ridley, it is distinguished from both by its very different type of pubescence. Its relationship may also be with *P. myriantha* Perk., a species with sparser pubescence throughout, smaller leaves, and much smaller flowers.

ISOMEROCARPA gen. nov.

Arbores saepe procerae, foliis oppositis petiolatis, laminis chartaceis vel coriaceis margine serratis vel subcrenatis; inflorescentiis axillaribus solitariis brevibus cymosis paucifloris pedunculatis; floribus hermaphroditis pedicellatis ubique glandulosis saepe ternatis, bracteis parvis caducis, pedicellis apice bracteolas 2 papyraceas valvatim involucrantes mox deciduas gerentibus, cicatricibus sub anthesi conspicuis; receptaculo carnoso urceolato extus apicem versus tepala stamina et staminodia gerente; tepalis 8 biseriatis tenuiter coriaceis oblongis sub anthesi patentibus, 4 exterioribus et 4 interioribus similibus; staminibus 4–9 carnosis, filamentis brevissimis crassis utrinsecus glandula aliformi auctis, antheris extrorso-lateraliter bilocellatis, locellorum valvis sursum dehiscentibus, connectivo in appendiculam complanatam producto; staminodiis 2- vel 3-seriatis intra stamina 9–16 lanceolato-oblongis, exterioribus manifeste majoribus; carpellis 10–12 in fundo receptaculi congestis, in stylos subulatos exsertos desinentibus, ovulo basim ovarii versus suberecto; receptaculo fructifero ellipsoideo vel anguste ovoideo coriaceo in valvas 3 vel 4 subaequales dehiscente, fructus carpellis inclusis angustis longe pilosis in stylos longos desinentibus, pericarpio tenui semini adnato.

Isomerocarpa is proposed to include *Daphnandra novoguineensis* Perk., originally described on the basis of a fruiting specimen; in this condition the plant is indeed so suggestive of the Australian species of *Daphnandra* that one would not seriously question its place, although the dehiscence of the fruiting receptacle is different. In describing a second New Guinean species of this alliance, Gilg and Diels (Notizbl. Bot. Gart. Berlin **9**: 466. 1925) apparently did not consider the generic placing of their plant, as flowering specimens are quite unlike those of *Daphnandra*. The presence of involucrate bracteoles beneath each flower is in itself a sufficiently pronounced character to remove the New Guinean species from *Daphnandra* according to Perkins' key to genera (Pflanzenr. 4 (IV. **101**): 14. 1901).

Isomerocarpa differs from *Daphnandra* in the presence of the above-mentioned involucrate bracteoles, in having the tepals 8 and the members of both series similar in number and texture (the tepals of *Daphnandra* being 10–15, those of the inner series more numerous, larger, and thinner in texture than those of the outer), in the somewhat produced and conspicuouly flattened anther-connective, in the essentially basal rather than pendulous ovule, and in having the fruiting receptacle dehiscing into three or four subequal valves (rather than inequilaterally along one side as in *Daphnandra*).

A closer relative of the new genus appears to be the Australian *Atherosperma* Labill., which agrees with the New Guinean plants in having paired bracteoles beneath each flower. *Isomerocarpa,* however, differs from *Atherosperma* in having its flowers hermaphrodite rather than dioecious or polygamo-monecious, in having its stamens 4–9 rather than 10–16 and its filaments inconspicuous (those of *Atherosperma* being slender and obvious), in its produced anther-connective, and in its ellipsoid fruiting receptacle (that of *Atherosperma* being either subglobose or urceolate). The staminate flowers of *Atherosperma* completely lack both staminodes and carpels, the receptacle being flattened, while the pistillate flowers have more numerous (at least 25) carpels than those of *Isomerocarpa.* The staminodes of *Atherosperma,* present only in pistillate flowers, are arranged on the inner surface of the receptacle above the carpels, while the new genus has the staminodes on the distal outer surface of the receptacle.

Isomerocarpa, a member of the Subfamily Atherospermoideae, Tribe Laurelieae, according to Perkins' treatment, seems to have as strong a combination of characters as any of the five genera of this relationship treated in the *Pflanzenreich.* These genera, although small, are well marked and will presumably seem quite acceptacle to future monographers. The name of the new genus refers to the fact that the fruiting receptacle splits into equal valves.

Isomerocarpa novoguineensis (Perk.) comb. nov.

Daphnandra novoguineensis Perk. Bot. Jahrb. 52: 217. *f. 5.* 1915.

Northeastern New Guinea: Morobe District, Ogeramnang, alt. about 1800 m., *Clemens 4598* (tall tree in forest hills, the trunk 38–60 cm. diam., the buds greenish white), *4796, 5456;* Yunzaing, alt. about 1400 m., *Clemens 3853* (tall tree, the trunk 60 cm. diam. or more; fruit green; tree growing with *Calophyllum* sp.). British New Guinea: Central Division, Ononge Road, alt. 500 m., *Brass 3913* (gray-barked tree in rain-forest, the leaves thick, dark, pale beneath; flowers brown;

fruit green, hard). NETHERLANDS NEW GUINEA: Balim River, *Brass & Versteegh 11194* (on forested slopes at 2160 m.; tree 26 m. high, the trunk 60 cm. diam., the crown fairly wide-spreading, the bark thick, gray, 18 mm. thick, the wood brown; flowers red; fruits green); 4 km. southwest of Bernhard Camp, Idenburg River, alt. 900 m., *Brass 13085* (common subsidiary tree 10–12 m. high, in mossy forest; flowers yellow, with red stamens); 15 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 11948* (tree 25 m. high, frequent in primary forest at 1590 m. alt., the trunk 44 cm. diam., the crown not wide-spreading, the bark 11 mm. thick, dark brown, the sap-wood yellow, the heart-wood brown-yellow; fruits light green), *11984* (tree 31 m. high, frequent in primary forest on the slope of a ridge at 1900 m. alt., the trunk 60 cm. diam., the crown not wide-spreading, the bark 12 mm. thick, rough, fissured, the sap-wood light yellow, the heart-wood brown-yellow; flowers red).

The species has previously been reported only from Northeastern New Guinea. The above-cited specimens agree well with the original description, although they may equally well be referred to *Daphnandra Perkinsiae* Gilg & Diels. From a comparison of the two descriptions I am inclined to doubt the existence of two species, as the differences in leaf-size, texture, apex, and punctation mentioned by Gilg and Diels seem very slight. In general, it appears that specimens from higher elevations have thicker and smaller leaf-blades, but I fail to find specific differences among those cited. The reduction cannot definitely be made without examination of the two types.

ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

PLANTAE PAPUANAE ARCHBOLDIANAE, VI*

E. D. Merrill and L. M. Perry

The Papuan material under study contains representatives of several families with but a few numbers each. In some groups considered below the material is entirely from Netherlands New Guinea (Third Archbold Expedition), the Fly River collections having previously been named and recorded, while in others our total material of the family is considered. Included also are a few specimens, misplaced in the original hasty ordering up of the collections for reference, representing families previously considered. The new species and the range extensions here recorded were detected in our effort to complete the identifications of the material in certain of these smaller families. As far as we know, no representatives of the genera *Elaeagnus, Crypteronia, Duabanga,* and *Callitriche* have previously been reported from New Guinea. *Elaeagnus* and *Callitriche* were to be expected, as both have long been known as occurring in Malaysia and in Australia. *Duabanga* and *Crypteronia* are small genera characteristic of Malaysia, New Guinea perhaps representing the southeastern limits of their geographic range.

ULMACEAE

Celtis Linnaeus

Celtis similis sp. nov.

Arbor 8 m. alta, trunco 25 cm. diametro; ramulis brunnescentibus glabris, novellis adpresse pubescentibus, pilis flavescentibus; foliis subcoriaceis petiolatis, pro more affinium eximie trinerviis, lanceolato- ad ovato-ellipticis, 2.5–5 cm. longis, 1.2–2.2 cm. latis, basi subrotundatis vel obtusis paullo obliquis, apice saepe longe acuminatis, acumine 0.4–1.2 cm. longo, acuto vel subapiculato, margine integris vel supra medium remote serratis, supra glabris vel novellis parce pubescentibus, subtus praecipue in costa nervisque primariis parce pubescentibus, axillis plerumque minute fasciculato-barbatis; costa recta in tertia parte supera nervos utrinsecus 1–2 emittente, nervis basalibus 2 superne evanescentibus, exterius ± 4 venas laterales arcuatim anastomosantes emittentibus; venularum reticulo ± inconspicuo; stipulis ipsis non visis; petiolo

*(Botanical Results of the Richard Archbold Expeditions) See Jour. Arnold Arb. **20**: 324–345. 1939; op. cit. **21**: 163–200, *t. 1.* 1940; op. cit. 292–327; op. cit. 511–527; op. cit. **22**: 32–59. 1941.

1.5–3 mm. longo, adpresse pubescente; cymis axillaribus fructiferis ± 1 cm. longis, pedunculis 3–5 mm. longis, pubescentibus; drupis late ellipsoideis, leviter compressis, apice pubescentibus obtuse apiculatis, putamine 2 mm. longo, 2.5 mm. lato, ruguloso.

NETHERLANDS NEW GUINEA: Balim River, *Brass & Versteegh 11168* (TYPE), December 1938, alt. 1600 m., relic strip of primary forest on river bank (tree 8 m. high, 25 cm. diameter; bark gray; fruit green).

Celtis similis is undoubtedly closely related to *C. rubrovenia* Elmer of the Philippine Islands. The leaves, petioles and fruits are a little smaller than in the latter species, and the new growth is densely pubescent. Further, the leaves lack the puncticulations characteristic of the Philippine species, and differ also in that, usually, minute tufts of hairs are present in the axils of the larger veins on the lower surface.

Celtis Kajewskii sp. nov.

Arbor usque 25 m. alta; ramulis cinereo-brunnescentibus glabris, innovationibus pubescentibus; foliis subcoriaceis, petiolatis, trinerviis, ovato-ellipticis, 10–19 cm. longis, 6–10 cm. latis, apice (± fractis) probabiliter acuminatis, basi rotundato-obtusis vel brevissime cuneatis, paullo obliquis, margine integris, supra glabris vel costa nervisque parce pubescentibus, subtus praecipue in costa venisque parce pubescentibus; costa recta, nervis primariis 2 tantum conspicuis a basi ad apicem laminae arcuatim productis, exterius venas laterales plures intra marginem arcuatim anastomosantes emittentibus, venularum reticulo supra manifesto, subtus prominulo; stipulis ipsis non visis; petiolo 7–10 mm. longo, ± adpresse pubescente; cymis fructiferis usque 5 cm. longis; drupis elongato-ovoideis subtetragonis, 2 cm. longis, ± 1.5 cm. latis, stigmate bilobo coronatis, parce pubescentibus vel glabratis.

SOLOMON ISLANDS: Guadalcanal, Berande, *Kajewski 2445* (TYPE), January 1931, common in rain-forest at sea level (very large tree up to 25 m. high, with straight stem and little buttressed or not; fruit orange-colored when ripe, 2.5 cm. long, 1.6 cm. broad, oval shaped with a point at the end). NEW BRITAIN: Keravat Experiment Station, near Rabaul, *Kanehira 3964*.

The characters of this species approach those of *C. Zippelii* (Blume) Planchon as given in the description; in the latter, however, the two main nerves do not extend to the apex of the leaf, and the leaves are glabrous.

Parasponia Miquel

Parasponia rigida sp. nov.

Arbor usque 6 m. alta; ramulis teretibus, adpresse pubescentibus vel glabratis; foliis coriaceis alternis petiolatis lanceolatis haud ovatis, usque

8.5 cm. longis, 2.3 cm. latis, basi rotundatis paullo obliquis, apice acute acuminatis, margine in sicco leviter revolutis serrulatis, trinerviis, supra scabridulis (pilis basi bulbosis vel pustulatis), rugosis, costa atque 2 nervis adpresse pubescentibus, subtus adpresse pubescentibus ac manifeste dense reticulatis; nervis basilaribus usque ad apicem productis arcuatis, exterius venas laterales plures longiuscule arcuatas intra marginem anastomosantes emittentibus, costa interdum unam venam lateralem emittente; petiolo ± 8 mm. longo, adpresse pubescente; stipulis in costis adpresse pubescentibus in unam stipulam intrapetiolarem circiter 8 mm. longam bicuspidatam connatis; cymis axillaribus, circiter 1 cm. longis; rhachi adpresse pubescente; bracteis ovatis, fere acuminatis, circiter 1 mm. longis; floribus parvis monoicis; ♂ : perianthio 5-partito, laciniis imbricatis late obovato-ellipticis, 1.6 mm. longis, 1.2 mm. latis, obtusiusculis puberulis ciliatis; staminibus 5, filamentis 0.8 mm. longis, antheris 0.7 mm. longis, thecis oblongis, curvatis; pistilli rudimento 0.8 mm. longo angulato-obconico, apice medio paullo impresso, receptaculo hirsuto; ♀ : pedicellatis, pedicellis 1–1.5 mm. longis; perianthio 1.2 mm. longo, laciniis ovatis, puberulis, ciliatis; drupis ovoideis 2–2.4 mm. longis, 2.2 mm. latis, stigmatibus marcescentibus coronatis, basi perianthio suffultis.

Netherlands New Guinea: 18 km. southwest of Bernhard Camp, Idenburg River, *Brass 12459* (type), February 1939, alt. 2150 m., mossy forest, dominating young forest at the foot of a rock-slide (tree up to 6 m. high; branches flat-spreading; fruit red).

This species is very close to *Parasponia melastomatifolia* J. J. Sm. differing chiefly in the lanceolate leaves with a serrulate margin. The ♂ and ♀ inflorescences are on different branchlets, and the outer lateral veins are long-arcuate before anastomosing.

Parasponia simulans sp. nov.

Arbor 4–5 m. alta; ramulis teretibus, adpresse pubescentibus ad glabratis; foliis subcoriaceis vel chartaceis, alternis petiolatis lanceolatis interdum elongato-ovatis, 5.5–11 cm. longis, 1.7–4 cm. latis, basi rotundatis paullo obliquis, apice acute acuminatis, margine in sicco leviter revolutis crenulato-serrulatis, trinerviis, supra vix scabridulis, costa parce pubescente, subtus costa venis venulisque adpresse pubescentibus, dense manifesteque reticulatis, novellis subtus pubescentibus; costa recta, nervis primariis 2 tantum, conspicuis, a basi ad apicem laminae arcuatim productis, exterius venas laterales plures breviter arcuatim anastomosantes emittentibus; petiolo 6–12 mm. longo, adpresse pubescente; stipulis in unam intrapetiolarem circiter 7 mm. longam bi-

cuspidatam adpresse puberulam connatis; inflorescentiis axillaribus, ± 1 cm. longis; rhachi adpresse pubescente; floribus monoicis; ♂ : perianthio 5-partito, laciniis obovato-ellipticis, ± 1.5 cm. longis, 1.2 cm. latis, adpresse pubescentibus, ciliatis; staminibus 5, filamentis 1.5 cm. longis, antheris 0.8 mm. longis, ovoideis, thecis oblongis, curvatis; pistilli rudimento angulato-clavato; receptaculo dense hirsuto; ♀ : perianthio ♂ conformi; drupis ovoideis 2.5 mm. longis, stigmatibus marcescentibus 0.8 mm. longis coronatis, putamine late subgloboso-ovoideo, 1.4 mm. longo, 1.8 mm. lato.

NETHERLANDS NEW GUINEA: 4 km. southwest of Bernhard Camp, Idenburg River, *Brass 13072* (TYPE), March 1939, alt. 850 m., common in seral rain-forest (tree 4–5 m. high).

Unquestionably *Parasponia melastomatifolia* J. J. Sm., *P. rigida* and this species are very closely related. Unfortunately we have only the plate and the original description of the first to compare with our species. *Parasponia simulans* appears to be separable from *P. melastomatifolia* J. J. Sm. by the lanceolate leaves with crenulate-serrulate margin and the relatively smooth upper surface. Comparing *P. simulans* with *P. rigida* Merr. & Perry, the following differences appear: the inflorescence of the former is more open, staminate and pistillate flowers are in the same inflorescence; the leaves are thinner, the lower surface is much less pubescent, the venation is less elevated, and the veins extending outward from the main nerves are only shortly arcuate.

ROSACEAE

Parastemon A. de Candolle

Parastemon Versteeghii Merr. & Perry, Jour. Arnold Arb. **21**: 197. 1940.

NETHERLANDS NEW GUINEA: Hollandia, *Brass 8948*, July 1938, alt. 20 m., common in dry open second growths (bushy tree 6–7 m. tall; fruits very numerous, white).

This specimen has practically mature fruits 1.7 cm. long, 0.7 cm. diameter. Their structure agrees entirely with that of the fruit of *P. urophyllus* A. DC. as delineated by Boerlage and Koorders, Ic. Bog. **1**: *t. 97.* 1901.

MELIACEAE

Dysoxylum Blume

Dysoxylum Whiteanum sp. nov.

Arbor alta; foliis alternatis, 50–60 cm. longis, 3–5-jugis, pari- atque impari-pinnatis, novellis dense apresse pubescentibus mox glabratis, petiolatis, petiolo usque 10 cm. longo, supra applanato, glabrato; foliolis

suboppositis petiolulatis chartaceis, oblongis vel inferioribus oblongo-ellipticis, 6.5–20 cm. longis, 4–6 cm. latis, basi, foliolo terminali excepto, oblique brevissime cuneatis, apice obtusis abrupte in acumen angustum ± 1 cm. longum productis utrinque glabris; venis primariis utrinsecus 12–21 obliquis, supra manifestis, subtus vix prominulis; petiolulis 1–1.8 cm. longis, terminali 3–3.5 cm. longo; racemis fasciculatis pendentibus, in axillis foliorum vel in ramulis defoliatis, usque 19 cm. longis, rhachi ac bracteis minutis adpresse pubescentibus; floribus albis sessilibus; calyce crateriformi circiter 4 mm. longo, leviter 4-lobato, adpresse pubescente, lobis vix 1 mm. longis liberis, apice parce pubescente excepta glabris; tubo stamineo circiter 6 mm. longo, utrinque glabro 8-fido, laciniis 2 mm. longis apice emarginatis, antheris 8 inter lacinias affixis, circiter 1.5 mm. longis; tubulo cylindrico 2 mm. longo, crenulato, extus margine ± dense pubescente excepta glabro, intus parce pubescente; ovario dense adpresse pubescente, 4-loculari, stylo adpresse pubescente, stigmate discoideo.

British New Guinea: Lower Fly River, east bank opposite Sturt Island, *Brass 8005* (type), October 1936, rain-forest, common on river-flats flooded by tides (profusely flowering tall canopy tree with widely flanged base; bark reddish brown, lenticellate; leaves to 50–60 cm. long; flowers white, in pendent racemes, fasciculate in leaf-axils and lateral on smaller branches).

In several characters this species suggests *Dysoxylum Pettigrewianum* F. M. Bail. It may be distinguished from the latter by the longer pendent inflorescences, the incised (rather than crenulate) apex of the staminal tube, the shorter and less hairy tubular disk, and the oblong or oblong-elliptic rather than lanceolate leaflets.

Dedicated to Mr. C. T. White in appreciation of his extensive contributions to the knowledge of the botany of northeastern Australia and his interest in the flora of New Guinea.

Dysoxylum micranthum sp. nov.

Arbor gracilis parva; ramulis glabris lenticellatis, lenticellis albescentibus, innovationibus minute pubescentibus mox glabratis; foliis alternis, 3-jugis, pari-pinnatis, petiolatis; petiolo 2.5–4.5 cm. longo et rhachi 4–6 cm. longa glabris; foliolis oppositis, sessilibus vel subsessilibus, chartaceis, lanceolatis, 7–13.5 cm. longis, 2.3–3.5 cm. latis, utrinque angustatis, basi longe angusteque cuneatis atque paullo obliquis, apice obtuse acuminatis, acumine ± 5 mm. longo, utrinque glabris; venis primariis utrinsecus 11–14, obliquis marginem versus adscendentibus, manifestis vel inconspicuis; paniculis axillaribus vel supra-axillaribus, usque 9 cm. longis, ramis brevibus vix 1 cm. longis; floribus parvis, alabastris circiter 2 mm. longis, pedicellis circiter 0.5 mm. longis; calyce

0.8 mm. longo, 4–5-dentato, margine inconspicue ciliolato; petalis 4–5, late ovatis, 1.8 mm. longis, 1.2 mm. latis, acutiusculis, glabris, tubo stamineo in parte inferiore adnatis; tubo stamineo ½ longitudinem petalorum subaequante, 8–10-fido, glabro; antheris 8–10, oblongis, semiinclusis; tubulo urceolato, 0.6 mm. longo, extus glabro, intus infra marginem pubescente; ovario subgloboso, 0.8 mm. longo, minute pubescente, 3-loculari; stylo glabro, circiter 1 mm. longo, stigmate crasso discoideo.

SOLOMON ISLANDS: San Cristobal, Star Harbor, *Brass 3114* (TYPE), October 1932, alt. 100 m., rain-forest (slender small tree with green flowers).

In the abruptly pinnate leaves and the very small flowers, this species shows some resemblance to the genus *Pseudocarapa* Hemsl.; nevertheless, on account of the free disk we have placed it in *Dysoxylum* Blume. Possibly it has an affinity with *D. arborescens* (Blume) Miq. At present we cannot suggest a species closely resembling it.

CALLITRICHACEAE

Callitriche Linnaeus

Callitriche papuana sp. nov.

Planta submersa; foliis caulinis et ramalibus linearibus uninerviis, apice profunde lunate excisis; floribus ♂ non visis; fl. ♀: ovario juvenili 0.3 mm. longo, stylis 1 cm. longis erectis vel subdivergentibus; ovario submaturo 1 cm. longo, stylis 2.2 cm. longis; fructibus maturis subsessilibus vel brevissime pedicellatis, 1.4–1.6 cm. longis, 1.2–1.4 cm. latis, suborbicularibus vel paullo longioribus quam latioribus, convexis, apice leviter cordatis, marginibus binis subapproximatis parallelis tenuiter subalatis, carinis latis acutiusculis.

NETHERLANDS NEW GUINEA: Lake Habbema, *Brass 9541* (TYPE), August 1938, alt. 3225 m., submerged (green) aquatic rooting in outer shallows of lake.

Apparently this is the first collection of *Callitriche* from New Guinea. We have been unable to match the material with any herbarium specimens or with any of the descriptions of Asiatic or Australian species. It is most like *C. stagnalis* Hegelm., but the latter has fruits more broadly winged and the apex of the leaves is emarginate rather than roundly incised.

AQUIFOLIACEAE

Ilex Linnaeus

Ilex scabridula sp. nov.

Scandens; ramis longis pendentibus; ramulis subferrugineis scabridulis ± angulatis gracilibus; foliis valde coriaceis glabris, ovatis ad oblongis,

3–7 cm. longis, 1.4–3 cm. latis, basi obtusis vel rotundatis, apice acuminatis vel interdum acutis, acumine 0.5–1 cm. longo, subapiculato, margine integris vel in parte tertia superiore 2–4-serrulatis, subtus glanduloso-punctatis; costa media supra canaliculata, subtus prominula; venis primariis supra obscuris, subtus utrinsecus 6–9 prominulis rectis vel juxta marginem arcuatim confluentibus, minoribus interdum majoribus intermixtis; petiolo 2.5–4 mm. longo, nigrescente glabro; racemis solitariis axillaribus, 1.5–3.5 cm. longis, rhachi parce pubescente, pedicellis circiter 3 mm. longis, parce pubescentibus, basi bracteatis, bracteis subrotundatis, ± 1 mm. longis; calyce 4–5-mero glabro, lobis rotundatis margine parce atque obsolete ciliolatis; corolla rotata, petalis oblongis apice rotundatis vel obtusis, circiter 2.5 mm. longis; staminibus fl. ♂ petalis fere aequalibus, antheris ovoideis, 0.8 mm. longis; pistillodio subangulato-pulviniformi, medio apiculato, circiter 0.8 mm. diametro; staminodiis fl. ♀ quam petalis brevioribus, antheris minutis; ovario obtuse ellipsoideo, compresso, 6–10-loculari, stigmate magno crasso discoideo elliptico, 1.2 mm. longo, 0.4 mm. lato; drupis ellipsoideis, 3 mm. longis, 2.5 mm. diametro, obsolete longitudinaliter sulcatis.

Netherlands New Guinea: 9 km. northeast of Lake Habbema, *Brass 10502, 10775, 11006* (type), October 1938, alt. 2800 m. and 2900 m., frequent in mossy forest of moist valleys (large liane with pendent branches forming long hanging masses of foliage; flowers white; fruit small, black).

Although somewhat resembling *Ilex spicata* Blume, this species is readily distinguished by the scabridulous branchlets; the glandular dots on the lower surface of the leaves are fairly numerous and readily seen with a hand lens; while the leaf-margin is sometimes remotely serrate towards the apex of the leaf.

Ilex Versteeghii sp. nov.

Arbor usque 21 m. alta glabra; ramis teretibus cinereis, plerumque lenticellatis; ramulis brunnescentibus subangularibus; foliis valde coriaceis subnitidis, ellipticis vel oblongis, 3.5–7(–11) cm. longis, 1.5–3.5 cm. latis, basi obtusis vel late cuneatis interdum rotundatis, apice obtusis vel retusis vel subemarginatis, margine integris plerumque revolutis, supra olivaceo-viridibus, subtus pallidioribus vel brunnescentibus non punctatis; costa supra canaliculata, subtus prominente; venis primariis utrinsecus 6–9, supra impressis, subtus prominulis, rectis ad marginem curvatis atque anastomosantibus; petiolo 4–8(–14) mm. longo, atro; inflorescentiis axillaribus, breviter pedunculatis, plerumque bis interdum ter dichotomis, 3–13-floris, pedunculo 3–7 mm. longo, pedicellis ± 3 mm. longis; floribus 5-meris; calyce glabro, lobis rotundatis minute ciliolatis;

corolla rotata, lobis oblongis rotundatis, circiter 3 mm. longis; staminibus fl. ♂ quam petalis paullo brevioribus, antheris ovoideis, 1 mm. longis; pistillodio depresse angulato-conico; staminodiis fl. ♀ non visis; ovario depresse ovoideo, 4–6-loculari, stigmate crasso discoideo, inconspicue 5-lobato, circiter 1 mm. diametro; drupis ovoideis vel subglobosis, 4 mm. longis, 3.5 mm. diametro.

NETHERLANDS NEW GUINEA: Balim River, *Brass & Versteegh 11192* (TYPE), December 1938, alt. 2180 m., forests of the slopes (tree 17 m. high, 35 cm. diameter; fruits red); *Brass 11662,* December 1938, alt. 1600 m., scattered over grassy deforested slopes (shrub 2 m. high; leaves smooth and shining, margins recurved; flowers white); 9 km. northeast of Lake Habbema, *Brass 10262, 10263, 10654,* October 1938, alt. 2800 m., common in substage of valley forests and also in old secondary forests (tree 10–15 m. high; flowers white); *Brass & Versteegh 10455,* October 1938, alt. ± 2930 m., frequent in mossy forest on ridge (tree 20 m. high, 28 cm. diameter; flowers white); Bele River, 18 km. northeast of Lake Habbema, *Brass 11290,* November 1938, alt. 2350 m., fagaceous forest of slopes, frequent in young seral growths (tree 2–3 m. high; leaves stiff, convex); 6 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 12576,* February 1939, alt. 1350 m., frequent in primary forest (tree 21 m. high, 48 cm. diameter).

Brass 11290 is somewhat aberrant in having very long leaves. The branchlets of *Brass & Versteegh 12576* (a sterile specimen) are much lighter in color than those of the other collections. Possibly the following two collections from Balim River also belong in this species: *Brass 11771, 11772,* December 1938, alt. 1800 m. and 1700 m., common in brushy growths on dry, stony, long deforested slopes (shrub or small tree 1–3 m. high; leaves smooth and shining; flowers white). The leaves are smaller than those of the other collections, but we have not yet found any specific differences.

In the grayish branchlets and the entire impunctate leaves, *Ilex Versteeghii* is closely allied to *I. Archboldiana* Merr. & Perry; the latter, however, is a compact tree with denser foliage; the leaves are smaller, and the mesocarp is much thinner than in *I. Versteeghii.*

CELASTRACEAE

Celastrus Linnaeus

Celastrus novoguineensis sp. nov.

Probabiliter frutex scandens, glaber; ramulis teretibus vel apicem versus subangulatis, atrobrunneis, lenticellatis, lenticellis numerosis,

pallidis; foliis alternis, tenuiter coriaceis, oblongis ad ellipticis, 13–16 cm. longis, 5–7.5 cm. latis, basi obtusis vel rotundatis, apice obtusiusculis vel acutiusculis, margine minutissime remotiusculeque serrulatis, leviter revolutis, in sicco plerumque pallide viridescentibus; costa supra subplana subtus prominula; venis primariis utrinsecus 7–8 patentibus arcuatim adscendentibus, utrinque manifestis ± prominulis, reticulo laxiusculo ± distincto; paniculis terminalibus, 15–20 cm. longis, ramis 3–6 cm. longis, divaricatis vel oblique adscendentibus; ramulis usque 1–1.5 cm. longis; pedicellis 1 mm. longis; bracteis deltoideis, 0.6 mm. longis; floribus parvis; calyce 2 mm. longo, 5-lobato, lobis brevibus, rotundatis; petalis 5, ellipticis 2.5 mm. longis, staminibus 5 in margine disci locatis, filamentis brevissimis vix ullis, antheris 1 mm. longis, oblongis, subauriculatis; disco cupuliformi, 1 mm. longo, non crasso; ovario subgloboso, 0.8 mm. longo, 1.1 mm. diametro, 3-loculari; stylo brevi; stigmate quam stylo latiore 3-lobulato, lobulis bifidis; capsulis loculicide trivalvis, valvis 1 cm. longis, extus inconspicue transverseque corrugatis; seminibus ± ellipsoideis, 8 mm. longis.

Northeastern New Guinea: Ogeramnang, *Clemens 5152* (type), *5394*, January and February 1937, alt. ± 1750 m.; Yoangen, *Clemens 6606*, June 1937, alt. ± 1250 m.

In some characters this species suggests *Celastrus papuanus* Warb., but the latter has smaller leaves and a racemose panicle with very short branches (only 6–8 mm. long). *Clemens 3523*, a fragmentary specimen from Yunzaing may also belong here.

Perrottetia Humboldt, Bonpland & Kunth

Perrottetia traumatophylla sp. nov.

Arbor 5–7 m. alta, glabra; ramulis brunnescentibus lenticellatis, lenticellis numerosis ovalibus pallidis; foliis alternis 2–3 cm. remotis, chartaceis vel subcoriaceis, oblongo-ellipticis utrinque angustatis, 9–15 cm. longis, 3.5–6 cm. latis, basi obtuse cuneatis, apice breviter acuminatis apiculatis, margine integris vel interdum apicem versus remote minuteque denticulatis, costa supra subplana, subtus prominente; venis primariis utrinsecus 7–8 supra manifestis interdum depressis, subtus perspicuis, oblique arcuatim patenti-adscendentibus, intra marginem 2–3 mm. anastomosantibus, venulis paucis manifestis; petiolo circiter 7 mm. longo; paniculis axillaribus, 4–9 cm. longis, sub lente pulvereo-papillosis, bracteis minutis deltoideis, pedicellis fructiferis vix 1 mm. longis; floribus perparvis, ovario excepto 5-meris; calycis lobis triangularibus vix

1 mm. longis, pulvereo-papillosis; petalis paullo longioribus, apice acutis, pulvereo-papillosis; staminibus brevissimis, in disci margine insertis; disco crassiusculo; ovario ovoideo, biloculari, stylo crassiusculo, stigmate bilobo; baccis 3–4 mm. diametro, bilocularibus, 4-spermis; seminibus 2–2.5 mm. longis, testa rugulosa.

NETHERLANDS NEW GUINEA: 9 km. northeast of Lake Habbema, *Brass 10968* (TYPE), October 1938, alt. 2750 m., common in forest openings on the lower slopes (flat branching tree 5–7 m. high; flowers green); Bele River, 18 km. northeast of Lake Habbema, *Brass 11528*, November 1938, alt. 2400 m., common in forest undergrowth (tree 5–6 m. high; flowers green).

Perrottetia traumatophylla shows some likeness to *P. nervosa* Ridl. in the few prominent primary veins anastomosing well within the margin of the leaves. The leaves, however, are not rounded at the base, the petals are longer than the sepals, the inflorescence is much longer, and the fruit is a little larger than that of *P. nervosa* Ridl. On the lower surface of the leaves, particularly near the veins, many minute punctures indicate the presence of domatia; hence, the specific name *traumatophylla*.

SABIACEAE

Meliosma Blume

Meliosma Schlechteri sp. nov.

Ramuli subangulati, apicem versus ± ferrugineo-hirsuti; foliis imparipinnatis, alternis, 3–5-jugis; petiolo rhachique 8–20 cm. longis, ferrugineo-hirsutis, pilis detergibilibus; petiolulis 5–7 mm. longis, terminali 1.2 cm. longo, hirtellis; foliolis coriaceis, oppositis, oblongo-ellipticis, 4–9.5 cm. longis, 2.6–4 cm. latis, basi obtusis vel subrotundatis leviter obliquis vel superioribus cuneatis, apice obtuse acuminatis apiculatis, acumine 3–7 mm. longo, margine integris vel apicem versus remote minuteque 3–5-dentatis, supra glabris, subtiliter reticulatis, costa plerumque pubescentibus, subtus distincte reticulatis, praecipue costa venisque breviter pilosis, axillis inter venas ac costam ± fasciculato-barbatis; venis primariis utrinsecus 7–9, supra impressis, subtus prominulis; inflorescentiis ± 30 cm. longis, divaricatim ramosis, hirtellis, floribus tantum glabris; sepalis rotundatis, glanduloso-ciliatis; petalis exterioribus obovato-orbicularibus, interioribus dorso filamentorum adnatis, utrinque in appendiculam brevem productis; staminodiis connatis; disco subannulari quam ovario glabro paullo breviore, margine irregulariter lobato, lobis subulatis.

NORTHEASTERN NEW GUINEA: woods of Kani, *Schlechter 18292* (TYPE) September 1908, alt. 1000 m.

This species is undoubtedly very closely related to *Meliosma humilis* Merr. & Perry. It differs in its practically entire and much more coriaceous leaves. It is also much less pubescent than the latter species.

RHAMNACEAE

Ventilago Gaertner

Ventilago papuana sp. nov.

Planta magna scandens; ramulis puberulis fuscis, innovationibus ± dense pubescentibus; foliis tenuiter coriaceis, late ellipticis, 4.5–12 cm. longis, 2.5–7 cm. latis, basi rotundatis, apice abrupte acuminatis, acumine 0.5–1.5 cm. longo, 0.3–0.5 cm. lato, obtuso, margine integris vel obsolete remoteque crenulatis, maturis utrinque glabris, novellis subtus puberulis, in utraque pagina dense manifesteque reticulatis; venis primariis utrinsecus 6–8 curvato-adscendentibus; petiolo 6–9 mm. longo tereti vel minute canaliculato, puberulo vel glabro; racemis 4–13 cm. longis, axillaribus atque subterminalibus, minute pubescentibus; axi hinc inde anguloso; floribus exiguis, fasciculatis, pedicellatis; pedicellis 1 mm. longis; calyce extus minute pubescente, lobis acutis circiter 1 mm. longis; petalis obovato-deltoideis emarginatis; staminibus quam petalis paululo longioribus; disco prope stylum parce pubescente, caeterum glabro; stylo bipartito basi pubescente, apice vix incrassato; fructibus immaturis usque 4 cm. longis alis inclusis, basi puberulis, ala oblonga, ± reticulatim venosa; semine non viso.

BRITISH NEW GUINEA: Lower Fly River, east bank opposite Sturt Island, *Brass 7973* (TYPE), October 1936, occasional on the ridges (rain-forest canopy liane; flowers yellow).

In some characters this species suggests *Ventilago cernua* Tul. from Rawak Island. The latter species, however, has much shorter petioles (about 3 mm. long) and fewer and somewhat more ascending primary veins. We are indebted to Monsieur R. Metman, Muséum d'Histoire Naturelle, Paris, who, previous to the outbreak of hostilities, very kindly lent us a flower and a leaf from the type of *Ventilago cernua* Tul. for comparison with our material.

Another collection which may belong to this species is *Brass 14058*, Bernhard Camp, Idenburg River, April 1939, alt. 50 m., rain-forest of flooded river plain (common large liane in forest edges). This specimen has spreading rather than appressed pubescence on the inflorescence, and is without fruits.

Colubrina Richard ex Brongniart

Colubrina papuana sp. nov.

Arbor magna; ramulis atro-fuscis, innovationibus fulvo-pubescentibus mox glabratis; foliis alternis membranaceis integris, ellipticis ad oblongis, 5–10 cm. longis, 2–5 cm. latis, basi obtusis, in apicem obtusum recurvum angustatis, maturis utrinque glabris, novellis subtus ± pubescentibus mox glabratis, penninerviis; venis primariis utrinsecus 5–7, oblique adscendentibus; petiolo 0.5–1.5 mm. longo, puberulo ad glabro; paniculis ad ramulorum apicem axillaribus, circiter 4 cm. longis, axi ramulisque puberulis ad glabratis; floribus ante anthesim glabris pedicellatis, pedicellis 1.5 mm. longis; calyce ad medium 5-fido, lobis vix 2 mm. longis, acutis, intus cristatis; petalis ½ longitudinem calycis loborum subaequantibus, margine incurvis; staminibus brevibus, probabiliter petalis subaequilongis; disco crasso 5-lobato, in margine brevissime libero; ovario in disco submerso calyci adnato, triloculari, stylo crassiusculo apice 3-lobato, lobis brevibus recurvis; fructibus depresso-globosis, leviter trisulcatis, circiter 1–1.5 cm. diametro, basi calycis patella suffultis, introrse dehiscentibus; epicarpio in sicco vix 0.4 mm. crasso, endocarpio crustaceo-sublignoso; semine compresse globoso, 1 cm. longo latoque 6 mm. crasso, testa rubra, puncticulata.

NETHERLANDS NEW GUINEA: Hollandia, *Brass 8986* (TYPE), August 1938, alt. 100 m., rain-forest (common large canopy tree; trunk spurred; bark corky-fibrous, rough; wood yellowish; flowers cream-colored; fruit orange); Bernhard Camp, Idenburg River, *Brass & Versteegh 14005*, April 1939, alt. 75 m., occasional on the lower slopes of primary rain-forest (tree 25 m. high; flowers yellow; fruit red).

BRITISH NEW GUINEA: Lake Daviumbu, Middle Fly River, *Brass 7459*, August 1936, common tree of rain-forest canopy (bark pale brown; fruit orange-colored; seeds red).

Although the general aspect of the collections suggest *Rhamnus*, on account of the thick disk and the partly inferior ovary, the plant seems to fall in the genus *Colubrina*. The valves of the fruit are coarser and firmer in texture than those of *C. asiatica* Brongn.

It is to be noted that Lauterbach, Bot. Jahrb. **57**: 326–340. 1922, does not include *Colubrina? Beccariana* Warb. in his treatment of the Rhamnaceae of Papuasia.

THYMELEACEAE

Gyrinops Gaertner

Gyrinops Ledermannii Domke, Notizbl. Bot. Gart. Berl. **11**: 349. 1932.

NETHERLANDS NEW GUINEA: 2 km. southwest of Bernhard Camp,

Idenburg River, *Brass 13672*, March 1939, alt. 750 m., rain-forest of the slopes (slender treelet 2 m. high; flowers white).

This collection seems to be a reasonably good match for the description of *Gyrinops Ledermannii* Domke, founded on a fruiting specimen of Ledermann from Northeastern New Guinea. *Brass 13672* shows a flowering branch and a young growing shoot. The leaves of the latter are 10.5–21 cm. long and 3–5.5 cm. broad, the larger ones are acuminate-caudate, the acumen being 2.5 cm. long, all are sparsely pilose beneath. This is a considerable variation from the measurements of the leaves of the type-specimen. The fascicles contain 3–6 flowers, the calyx-tube is 3 mm. long, the pistil is scarcely more than 3 mm. long, somewhat densely short-pilose, the ovary and stipe are hardly 2 mm. long, compressed obconical, the style and stigma are 13 mm. in length. The other floral characters and measurements coincide with those given in the original description.

Phaleria Jack

Phaleria subcaudata sp. nov.

Frutex magnus; foliis oppositis anguste obovato-oblongis, circiter 23 cm. longis, 7 cm. latis, petiolatis, basi obtusis vel late cuneatis, apice subabrupte longe acuminatis, acumine ± 2 cm. longo, integris chartaceis glaberrimis; costa subtus prominula; venis primariis utrinsecus 10–12 patenti-obliquis prope marginem anastomosantibus; venulis numerosis laxe reticulatis; inflorescentiis subumbelliformibus terminalibus probabiliter axillaribus; pedunculis circiter 5 mm. longis bracteatis; floribus numerosis albidis; involucri foliolis breviter ellipticis obtusis glabris; perianthii tubo infra angustissimo, apicem versus ampliato, extus glabro, intus minute parceque puberulo, ± 18 mm. longo, limbo quadrilobo, lobis 7 mm. longis obtusis margine tantum ± pubescentibus; staminibus longe exsertis, antheris ellipticis 0.6 mm. longis; stylo paullo exserto quam filamentis breviore; ovario parce puberulo; fructibus ignotis.

British New Guinea: Central Division, Kubuna, *Brass 5657* (type), November 1933, alt. 100 m., rain-forest (large straggling bush, very showy white flowers).

In foliar characters this species suggests *Phaleria capitata* Jack and *P. calantha* Gilg. It differs from the former in the larger number of primary veins, from the latter in the leaf-outline, and from both in having the perianth lobes pubescent only along the margins.

Phaleria Perrottetiana (Decne.) F. Vill. Novis. App. Fl. Filip. 183. 1880; Merr. Enum. Philipp. Fl. Pl. **3**: 131. 1923.

Drimyspermum Perrottetianum Decne. Ann. Sci. Nat. II. Bot. **19**: 38. 1843.

BRITISH NEW GUINEA: Western Division, Daru Island, *Brass 6057, 6240,* fairly common in light rain-forest (shrub 1–2 m. or more high; flowers white, fragrant; fruit red, fleshy); Lake Daviumbu, Middle Fly River, *Brass 7657,* occasional in rain-forest undergrowth (shrub or small tree 2–2.5 m. high; bark tough, fibrous; fruit smooth, red).

These specimens were determined in 1937 by Dr. W. Domke. The species has been collected previously in the Philippines and Borneo; this seems to be the first record for New Guinea. Possibly two collections from the Solomon Islands (*Kajewski 2698,* Guadalcanal Island, and *Kajewski 2237,* Bougainville Island) also belong here. The specimens show only very young buds.

Wikstroemia Endlicher

Wikstroemia venosa sp. nov.

Frutex ± 1 m. altus; ramulis hornotinis ± dense minuteque pubescentibus, annotinis fusco-purpureis glabris; foliis chartaceis vel leviter coriaceis, oppositis, lanceolatis vel lanceolato-ellipticis vel fere ovatis, 2–7 cm. longis, 1–3 cm. latis, basi late obtusis vel subrotundatis, apice acutis vel acutiusculis interdum obtusiusculis, utrinque glabris vel initio costa subtus ± pilosis; venis primariis distincte manifestis subirregularibus utrinsecus 7–10 patentibus deinde curvato-adscendentibus; petiolo brevi, 1–2.5 mm. longo pubescente; floribus viridibus vel flavis, pluribus, subspicatis vel subfasciculatis, saepissime inflorescentiis terminalibus interdum axillaribus; pedunculo 2–4 mm. longo, rhachi usque 11 mm. longo, adpresse pubescentibus, pedicellis brevissimis pubescentibus; perianthii tubo circiter 6.5 mm. longo et 1 mm. diametro, extus fere glabro, lobis 4 oblongis 2–2.5 mm. longis extus puberulis; antheris 8, linearioblongis, 1 mm. longis, filamentis brevissimis, eis seriei superioris faucem vix attingentibus, seriei inferioris paullo supra medium affixis; disci squama unica 1 mm. longa, apice biloba; pistillo 1.2 mm. longo, ovario fere glabro apice parce strigilloso, stylo 0.2 mm. longo, stigmate capitato; fructibus ellipsoideis utrinque leviter angustatis, 6–8 mm. longis, apice parce strigillosis.

NETHERLANDS NEW GUINEA: Balim River, *Brass 11667* (TYPE), December 1938, alt. 1600 m., deforested slopes, occasional on grassy banks of streams (shrub ± 1 m. high; flowers green; fruit red, fleshy); southern slopes of Balim Valley, *Brass 11612,* alt. 1700 m. (grassland shrub; flowers green). BRITISH NEW GUINEA: Central Division, Laloki River, Rona, *Brass 3577,* April 1933, alt. 450 m., on or about rocks on savannah, common (compact small tree with tough brown bark; lower leaf-surface glaucous; flowers yellow).

This species seems to be most like *Wikstroemia foetida* (L.f.) A. Gray, the leaves are firmer with a strongly marked venation, the inflorescence is spicate, occasionally subfasciculate. Possibly belonging to this species or surely closely allied to it is *Brass 3473,* Cape Prieto, Ysabel, Solomon Islands. The inflorescence here is longer-pedunculate and more loosely flowered. The genus is very much in need of critical revision.

Kelleria Endlicher

Kelleria patula sp. nov.

Suffrutex ramosissimus; caulibus vagantibus, decumbentibus; ramis erectis vel adscendentibus glabris cicatricatis; foliis alternis, inferioribus patentibus interdum reflexis, superioribus laxe imbricatis, lanceatis vel lineari-subulatis, 4–6 mm. longis, 1.5 mm. latis, obtusis, late sessilibus, convexis, 7–9-striatis, marginibus et apicibus sericeo-villosis; floribus ± 6 apice ramulorum confertis; pedicellis brevissimis pilosis; perianthio piloso, tubo subinfundibulari, 3 mm. longo circiter 1 mm. diametro, 8-venoso; lobis 1.2 mm. longis, patulis oblongis obtusis intus glabris; staminibus 4 cum perianthii lobis alternantibus, vix 1 mm. longis; faucis squamis ellipticis, discretis, basi loborum binatim inter staminum insertionem affixis; disco hypogyno nullo; ovario 1 mm. longo oblongo sessili, apice piloso, stylo 2.4 mm. longo, stigmate globoso parvo; fructibus ignotis.

Netherlands New Guinea: 11 km. northeast of Wilhelmina-top, *Brass & Myer-Drees 9806* (type), September 1938, alt. 3400 m., alpine grassland, plentiful on sandy banks of stream (bushy shrub 20–40 cm. high); *Brass & Myer-Drees 9671,* September 1938, alt. 3400 m., rather dry grassy place (very small shrub; corolla white, anthers orange-yellow; leaves grayish; twigs reddish brown).

This species differs from *Kelleria ericoides* (Hook. f.) Domke and *K. papuana* Domke in the coarser decumbent habit and the slightly larger and spreading rather than erect appressed leaves. Both the latter species have an erect habit and leaves rather stiffly erect and closely appressed.

ELAEAGNACEAE

Elaeagnus Linnaeus

Elaeagnus triflora Roxb. Fl. Ind. **1**: 459. 1821; Servettaz, Beih. Bot. Centralbl. **25**(2): 104. 1909.

Netherlands New Guinea: Balim River, *Brass 11703,* December 1938, alt. 1600 m., in a relic strip of *Castanopsis* forest (large scrambling

shrub; flowers white; fruit red, fleshy); 4 km. southwest of Bernhard Camp, Idenburg River, *Brass 13273,* March 1939, alt. 850 m., seral rain-forest (scandent shrub with yellowish flowers). NORTHEASTERN NEW GUINEA: Sattelberg, *Clemens 169, 468,* October 1935, alt. about 900 m., forest hill (scandent over trees; fruit tomato-red; flowers yellow, very fragrant).

We have not found any previous record of the presence of this genus in New Guinea, but it is to be expected as it has long since been reported from Malaysia and Australia. The specimens here cited represent the subsp. *tetragonia* Servett.

LYTHRACEAE

Rotala Linnaeus

Rotala mexicana Cham. & Schlecht. Linnaea **5:** 567. 1830; Koehne, Bot. Jahrb. **1:** 150. 1881, Pflanzenr. **17**(IV. 216)**:** 29. 1903; Val. Bull. Dept. Agr. Ind. Néerl. **10:** 36. 1907.

BRITISH NEW GUINEA: Western Division, Mabaduan, *Brass 6536,* April 1936, a wet season ephemeral plant growing on wet soil around pools in savannah-forest.

Since Mansfeld's treatment of the Lythraceae of Papuasia begins with the statement that this family is represented in New Guinea by *Ammannia, Pemphis* and *Lagerstroemia,* it seems worth while to record this second collection (leaves both decussate and whorled) of *Rotala mexicana* Cham. & Schlecht. from British New Guinea, and also to call attention to Valeton's previously published record of this species from Merauke, Netherlands New Guinea.

Lagerstroemia Linnaeus

Lagerstroemia Archeriana F. M. Bailey, Syn. Queensl. Fl. 196. 1883; Koehne, Bot. Jahrb. **4:** 408. 1883; F. M. Bail. Queensl. Fl. **2:** 678, *t. 24.* 1900; Koehne, Pflanzenr. **17**(IV. 216)**:** 264. 1903.

BRITISH NEW GUINEA: Western Division, Daru Island, *Brass 6239.*

The collection is a good match for *Brass 888* which Mr. C. T. White indicated as identical with *Lagerstroemia Archeriana* F. M. Bail. Koehne, in his treatment of the Lythraceae, assigned the species to section *Trichocarpidium* Koehne under the major caption, "Calyx aut ecostatis aut costis v. alis v. plicis sepalorum numero duplo munitus." The contrasting caption, "Calyx costis v. alis v. auriculis a latere complanatis tot quot sepalis munitus," separating the section *Pterocalymma*

(Turcz.) Koehne from the others, seems to us a more suitable place to look for this species. Bailey described the calyx of his plant as prominently six-ribbed; the latter is an obvious character of the New Guinean collections.

SONNERATIACEAE

Sonneratia Linnaeus f.

Sonneratia ovata Backer, Bull. Jard. Bot. Buitenz. III. **2**: 329. 1920.

British New Guinea: Western Division, Daru Island, *Brass 6264,* March 3, 1936, plentiful in landward edge of mangrove forests (handsome thick foliaged tree 15–20 m. high; branches spreading, short; a few large pointed pneumatophores over 30 cm. high and ± 6 cm. diameter; thick fissured, suberose, brown bark; leaves fleshy, nerves more prominent beneath; flowers white; fruit depressed, ± 5.5 × 3.5 cm.).

This species is based on specimens from Riouw, Java, Karimon Djawa Islands, Celebes and Moluccas. To this geographical range we now add New Guinea.

Duabanga Buchanan-Hamilton

Duabanga moluccana Blume, Mus. Bot. Lugd.-Bat. **1**: 109. 1849.

Netherlands New Guinea: 2 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 13514,* March 1939, alt. 750 m., occasional on slopes of primary rain-forest (tree 35 m. high; flowers yellow); Bernhard Camp, Idenburg River, *Brass & Versteegh 14015,* April 1939, alt. 75 m., occasional in primary rain-forest on lower mountain slopes (tree 27 m. high; fruit green). British New Guinea: Palmer River, 2 miles below Black River Junction, *Brass 7289,* July 1936, alt. 100 m., river flood-plain forest (branches stiff, robust, 1.5–2 m. long; petals in bud yellow-green).

Except for slightly larger (up to 4 cm. long) and possibly more conical fruits, these collections are a good match for the Malaysian specimens of *Duabanga moluccana* Bl. in our herbarium. It is to be noted that Knuth, in separating his *D. borneensis* from this species, mentions only the difference in the size of the capsule. We have not sufficient material at hand to determine the range of variation in the size of the fruits of *D. moluccana* Bl., but we are a little wary of using such a character without other supporting differences. This is apparently the first record of the genus from New Guinea.

CRYPTERONIACEAE

Crypteronia Blume

Crypteronia Cumingii (Planch.) Endl. Gen. Suppl. **4**(2): 39. 1847; Merrill, Enum. Philipp. Fl. Pl. **3**: 139. 1923.

Henslovia Cumingii Planch., Hook. Lond. Jour. Bot. **4**: 478, *t. 16, C. f. 1–4.* 1845.

NETHERLANDS NEW GUINEA: Bernhard Camp, Idenburg River, *Brass & Versteegh 13584,* April 1939, alt. 450 m., occasional in primary rain-forest (tree 24 m. high; buds green; bark dark brown, scaly).

Although this specimen has only very young flower-buds, we are reasonably sure it represents *Crypteronia Cumingii* (Planch.) Endl., a species previously known from the Philippines and Borneo. If we have not overlooked some reference, this is the first record of the genus in Papuasia.

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THE 1938–39 EXPEDITION TO THE SNOW MOUNTAINS, NETHERLANDS NEW GUINEA

L. J. Brass

With seven plates

INTRODUCTION

The 1938–39 expedition was the third of a series undertaken by Mr. Richard Archbold, Research Associate, American Museum of Natural History, for general biological exploration on the still imperfectly known and partly unexplored island of New Guinea. The first of these expeditions[1] covered in 1933–34 a section from Hall Sound on the south coast of the Territory of Papua to the summit of Mt. Albert Edward (3980 m.), and visited the Oriomo River, between the Fly River and the border of Netherlands New Guinea. The second expedition,[2,3] in 1936–37, examined the Fly River from the coast to the foothills of the central mountain complex, and the country of the Wassi Kussa River, also in Papua. The chief objective planned for the 1938–39 expedition was a cross section of the northern slopes of the Snow Mountains, from the Idenburg River to Mt. Wilhelmina, in Netherlands New Guinea.

The Snow Mountains, the most lofty section of the high central range of the island, rise to an elevation of 5000 m. in Mt. Carstensz, and six of the peaks — the Idenburg Mts., Mt. Carstensz, Mt. Wilhelmina, J. P. Coen Mts., Prins Hendrik Mt. and Juliana Peak — are capped with eternal snow. A large lake (Lake Habbema) was known to exist at an altitude of over 3000 m. on the north fall of the range, near Mt. Wilhelmina, and on this lake it was proposed to land a party by airplane and there establish a base for operations up and down the slopes.

As early as 1912 the Wollaston Expedition had penetrated from the south coast and reached the edge of the permanent snow on Mt. Carstensz; and in 1936 Colijn had led an expedition to its summit. Mount Wilhelmina was climbed from the south side by the Lorentz-van

[1] Archbold, Richard and A. L. Rand. Summary of the 1933–34 Papuan Expedition. Bull. Am. Mus. Nat. Hist. **68**: 527–579. 1935.

[2] Brass, L. J. Notes on the vegetation of the Fly and Wassi Kussa Rivers, British New Guinea. Jour. Arnold Arb. **19**: 174–190. 1938.

[3] Rand, A. L. and L. J. Brass. Summary of the 1936–37 New Guinea Expedition. Bull. Am. Mus. Nat. Hist. **77**: 341–380. 1940.

Nouhuys Expedition in 1909, and again in 1913 by the Herderschee Expedition. In 1921 the Kremer Expedition, approaching from the north past Lake Habbema, had also reached the summit of Mt. Wilhelmina. These expeditions, all but the last, had brought back collections from high altitudes on the Snow Mountains, but, owing to the difficult conditions under which they were made, and the short time spent at the upper levels, none was very extensive. In 1920, Lam, botanist to the van Overeem Expedition, made large gatherings of plants on the outlying Doorman-top. Several expeditions had made zoölogical and botanical collections on various parts of the Idenburg River.

To carry out the work projected it was necessary to seek the aid and co-operation of the Government of the Netherlands East Indies. This was given in full and generous measure, and a joint expedition, called the Indisch-Amerikaansche Expeditie, was formed under the general leadership of Archbold. A military covering party of 56 officers and men, under the command of Staff Captain C. G. J. Teerink, was provided by the Indies Government. Doctor L. J. Toxopeus was attached as entomologist, Dr. E. Myer-Drees as forester, and Mr. Ch. Versteegh as assistant forester. The American staff consisted of Dr. A. L. Rand, ornithologist and assistant leader, Mr. W. B. Richardson, mammalogist, and the writer in charge of botanical collections. Seventy-three Dyaks from east-central Borneo were recruited as carriers and field assistants for the scientific party. The military escort had a carrier force of 30 convicts — mostly Javanese. As finally constituted the expedition personnel numbered about 200 men.

For aërial transport, Archbold provided a two-engined Consolidated P.B.Y.2 flying-boat — the "Guba" — with a crew of four in charge of Pilot R. R. Rogers. To assure the co-ordination of operations essential to an expedition of the kind, the equipment included portable radio sets by means of which the various field parties could keep in touch with each other, maintain communications with coastal headquarters, and with the airplane while in flight.

* * * * * * *

The expedition yielded about 6000 numbers of plants in all, of which 69 per cent occurred above 1000 m. and 20 per cent at elevations exceeding 3000 m. With the exception of about 600 numbers from coastal localities and the Idenburg River, which Myer-Drees collected independently for Buitenzorg, these collections are deposited at the Arnold Arboretum. Before returning to Java in October, 1938, Myer-Drees assisted in general botanizing on Mt. Wilhelmina; and included in the

main collections are 602 numbers representing trees from which Versteegh took wood specimens for the Forest Research Institute, Buitenzorg.

The Pandanaceae, Ulmaceae, Pittosporaceae, Rosaceae, Geraniaceae, Oxalidaceae, Rutaceae, Meliaceae, Aquifoliaceae, Celastraceae, Sapindaceae, Rhamnaceae, Barringtoniaceae, Rhizophoraceae, and several other families represented by very few numbers have been determined by Dr. E. D. Merrill and Dr. L. M. Perry; the Theaceae and Oleaceae by Dr. C. E. Kobuski; the Myristicaceae, Monimiaceae, and Hippocrateaceae by Dr. A. C. Smith; the Musci by Dr. E. B. Bartram; and in part, the Boraginaceae by Dr. I. M. Johnston, the Selaginellaceae by Mr. A. H. G. Alston, the grasses by Mrs. Agnes Chase, and the ferns by Prof. E. B. Copeland. Numbers following a generic name in the text of this paper are the field numbers of the writer, under which collections made conjointly with Myer-Drees and Versteegh also appear. With some few exceptions, the generic names thus used are from a list of preliminary sight identifications kindly supplied by Dr. Merrill.

ITINERARY AND ROUTES

In April–June, 1938, a coastal base was established at Hollandia, a civil administration post and small settlement on the west side of Humboldt Bay, connected by monthly steamer with Makassar and Java. Then followed, between June 21 and 27, a series of four preliminary flights for the purpose of examining the country in which the inland party proposed to operate. The first aim of these flights was a reconnaissance of Lake Habbema, which, from its large size and situation among not too high ridges, proved eminently suitable for a high altitude air base. Mount Wilhelmina and its approaches were also examined at this time.

To ensure a safe retreat to the coast in the event of a mishap to the airplane, it was necessary to find a route, as short and direct as the nature of the country would allow, from Lake Habbema to the Idenburg River, and to select a site for an emergency supply base on the Idenburg. In successfully carrying out this part of the aërial reconnaissance, there was discovered, to the east of the route followed by Kremer's party, in country previously unexplored and unseen from the air, a very extensive system of heavily populated valleys that commenced little more than a day's walk from Lake Habbema and extended far north and northwest towards the Idenburg.

The northernmost of the new valleys drained to the Wal or Hablifoert River, a tributary of the Idenburg. Most of them were, however, laterals of a great central valley, to which the name "Groote Vallei" was given

by the Netherlands members of the party. About 80 km. long and up to 20 km. wide, this central valley had a bottom elevation of 1500–1700 m. and was found to be drained by the Balim (or Baliem) River, the headwaters of which were discovered by the Kremer Expedition in 1921. Flowing first west-northwest from the slopes of Mt. Wilhelmina and receiving the waters of Lake Habbema, the Balim described a wide loop to the east and southeast, then cut through the Snow Mountains in a deep gorge to join the Reiger, the main branch of the Lorentz River, which flows to the south coast.

The Grand Valley of the Balim, and many of its laterals, had been almost completely deforested up to elevations of 2300–2400 m. on the sides of the surrounding mountains. The utmost limit of cultivation was in the neighbourhood of 2500 m. Whole mountain ridges had been stripped of their original vegetation and their contours laid bare under a pale coating of grass. On these bald ridges were many village groups of gardens walled with stones, and marking their surface, in pleasing native irregularity, were the old walls which had enclosed former cultivation plots. The pock-marked effect given by sinkholes indicated that most of the country rock was limestone. In the main valley the plane flew low over numerous walled or stockaded villages and beautifully patterned gardens laid out on rich alluvial flats. Broad ditches in these gardens were in many cases full of water, for much of the valley bottom was low lying and swampy. A first estimate of 60,000 people in these, for New Guinea, highly cultivated valleys, was probably too conservative.

The usual direction flown from Hollandia on the reconnaissance and subsequent transport flights was approximately 240° for 200 km. to the Idenburg, then 220° for 100 km. to Lake Habbema or Mt. Wilhelmina. On this course, after leaving the hilly shores of Humboldt Bay, with their discontinous fringe of secondary grassland, the Cyclops Mts. were passed on their inland side and the plane flew over Lake Sentani.

Lake Sentani, beginning 10 km. from the coast, has a length of about 25 km., a width of 1–12 km., and lies at an elevation of 80 m. above sea level. From the air the lake is seen to be surrounded by hills partly covered with rain-forest but mostly by treeless grassland. Remarkably distinct lines of trees border the shores at the foot of the grassy hills and fill the gullies that score their sides. In some parts the shores are fringed with sago swamps. Off-lying valleys on the south and west sides look like dry arms of the lake. The lake carries a population of 7000 people, most of whom live in villages built on piles over the water. The grasslands are undoubtedly a secondary condition following deforestation by the natives. Clearing for gardens, the process by which these

grasslands are formed, can at any time be seen in operation on the forest edges. In the comparatively dry "winter" season of the southeast trade-winds, the fires which secure the invading grasses against the re-establishment of the original forest are almost a daily occurrence on some part of the area.

A somewhat scattered population continued westward on the line of flight for a distance of perhaps 30 km. from Lake Sentani. There, and in a parallel flat valley to the south of the lake, were extensive grassy areas, some of them secondary, others apparently patches of marshy land not suited for the growth of trees.

Beyond the disturbed area of Lake Sentani was a broad tract of low mountain country, completely forested, and carrying a very sparse population living in small villages or scattered solitary houses. Apparently of limestone, the mountains attained a fairly even elevation of perhaps 800 to 1000 m. and lay in closely parallel ridges trending east-southeast and west-northwest. When passing over them in early morning, there could be seen, when the weather was clear, two snow-capped peaks of the Central Range, far to the south. On one occasion, when flying at 3500 m. after a period of storms, Mt. Wilhelmina, with snow far down its sides and its top clear cut and icy, presented a magnificent sight, heightened in effect by a dark overcast and the blue-black of the lesser heights.

Between these still largely unexplored low mountains and the central mountain mass lies the valley of the Idenburg — the Meervlakte or Lake Plain. About 60 km. wide where it was crossed, the Meervlakte, as the name implies, is flat and swampy. Muddy tributaries loop over the plain to join the main river, which flows along the southern side, near the base of the central mountains. The Idenburg is a broad stream, winding and silt-laden, with an amazing number of cut off U-bends and often islands formed by the shifting of the channel. Out on the plain are big lagoons and areas of open grass marsh. Forests of swamp-inhabiting slender trees are conspicuous from the air and the open canopy and abundance of sago palms in more mixed forest further testify to the swampy nature of the ground. Later it was learned that even the dense closed forests are inundated to a depth of one to two meters for months on end in the season of the northwest monsoons.

The Meervlakte extends up the Idenburg for a distance of about 170 km. from the Mamberamo. Similar conditions are reported to prevail for about an equal distance on the Rouffaer River, the west branch of the Mamberamo. Probably the greater part of these areas is under water from December to May, when the rivers, dammed back by rapids on the Mamberamo, overflow their banks.

The first line of the central mountains rises sharply from the Meervlakte in a complex system of bold ridges which proved to consist of dark-coloured plutonic rocks. Except for one marshy valley draining into what is now known as Archbold Lake, areas deforested by natives, and the tops of the higher outlying peaks such as Angemoek and the Doorman-top, the ranges are forested up to high altitudes on the Snow Mountains. Practically every valley of consequence on the course from the Idenburg to the Balim carried some population. But not until Archbold Lake was passed did population have any great disturbing effect upon the forests. So far as could be seen from the air, the commencement of heavy population coincided with the change of the country rock to limestone.

The uniform reddish colour of the young leaves indicated some change, and a pronounced dominance, in the composition of the mountain forests (afterwards found to be of *Nothofagus*); for in their young-leaf colours the mixed rain-forests of lower levels presented a diversity of greens, yellows and browns, as well as reds. Above about 3000 m. on the slopes of the Snow Mts. the forests assumed a sombre hue, and soon after that long tongues of grassland, very different in appearance from the grasslands of the deforested valleys, descended in hollows from the alpine heights.

Lake Habbema lies in the outermost and shorter of two broad grassy valleys that run parallel to the axis of the range on a high, shelf-like plain. The Habbema valley is perhaps twice as long as the lake, which has a length of about 4 km., a width of 2 km., and is 3225 m. above sea level. The inner valley, in which a headwater stream of the Balim proper flows westward and the Wamena tributary eastward from an almost imperceptible divide, continues for an undetermined distance far to the west in the direction of Mt. Carstensz. The bottoms of these valleys of the high plain are flat and treeless. They contain many little pools and are drained by winding streams lined with the curious *Cycas*-like tree-ferns peculiar to high altitudes in New Guinea. There are also numerous pools on the tops of the smooth ridges that separate the two high valleys and form the rim of the Grand Valley. These ridges rise 75–125 m. above the plain, and carry shrubberies and mossy scrubs in which numerous slender conifers (*Libocedrus*) rise above the lower vegetation. There is little closed forest. From the air, cushions of golden-brown moss are conspicuous on the trees, and patches of the same colour appear in the shrubberies.

On the rugged main ridge of the Snow Mts., there was considerable low tree growth under bluffs and in other sheltered places up to an eleva-

tion of about 3900 m. The higher parts west of Mt. Wilhelmina consisted mainly of bare grey-white rock, frequently with a smooth weathered surface exhibiting a criss-cross pattern of cracks. On the summit of the strongly stratified knife-edged limestone ridge of Mt. Wilhelmina peak was a small area of permanent snow. Several small lakes and shallow ponds occurred on both sides of Mt. Wilhelmina about 1000 m. below the summit. A long narrow lake lay between two sharp ridges that formed a double crest to the range about a dozen kilometres to the east of the peak.

On one occasion the plane passed over the summit of Mt. Angemoek, an outlying, unexplored peak rising to 3950 m. a little to the west of the regular route. This peak was forested almost to the summit on the north side, while to the south it sloped down in a grassy plateau, perhaps 200 acres in extent, on which were two small ponds some 500 m. below the summit.

After the reconnaissance flights, a military detachment commanded by Lieut. V. J. E. M. van Arcken was landed on the Idenburg with carriers and stores for three months, for the purpose of establishing a river base, building canoes for use in case of an emergency, and exploring a route to the newly discovered Balim Valley. A trial landing with the airplane was then made on Lake Habbema. On July 19 began the transport flights to the lake, where, by the end of the month, 105 men, comprising scientific party and military covering party and carriers, with full equipment and food for ninety days, were landed in eleven trips.

Meanwhile, van Arcken was making his way in to the Grand Valley, where he was to be met by Teerink with a patrol from Lake Habbema. Guided by aërial photographs, notes and sketch maps made on the reconnaissance flights, and provisioned by parachutes dropped from the airplane, the two patrols met at a pre-arranged spot on the Balim River on August 13. This was a fine achievement, and an excellent illustration of the speed and precision with which exploration can be carried out with modern facilities and the efficient co-ordination of operations on land and in the air. Good contacts were established with the natives, the way prepared for work planned for the scientific party in the Grand Valley, and a land route opened up by which the highland party could, if necessary, withdraw from Lake Habbema to the Idenburg in 14 days of travel.

The month of August was occupied in collecting at Lake Habbema, and excursions were made to the slopes of Mt. Wilhelmina and down the slopes from the lake to examine possibilities for collecting and to choose sites for camps. On such excursions advantage was taken of

well defined native tracks which, ascending from the inhabited valleys, passed over the highlands in all directions and even crossed the summit of the range at an altitude of 3800 m.

September was spent at collecting camps established at 3560 m. and 3800 m. on the northern slopes of Mt. Wilhelmina. Attempts to reach the summit of the peak, extending over two weeks, were frustrated by bad weather. The highest point reached was attained by Archbold and Rand, who, approaching by the main ridge from the west, climbed through mist to an altitude of 4500 m.

Leaving a small military unit to maintain Lake Habbema Camp as a supply base, early in October the main party moved down the slopes toward the Grand Valley and established camp in high *Nothofagus*-forest at an altitude of 2800 m., five carrier hours from the lake. A subalpine type of forest dominated by *Podocarpus papuanus* Ridl., superior to any hitherto seen, extended down the slopes to 3100 m. The new camp was placed on the edge of a planted *Pandanus* grove, in which stood a well built hut roofed with bark. A sizable opening, resulting from the fall of several big old trees, had been enlarged and kept open by felling the smaller trees with stone tools and by ringbarking. The *Pandanus* (probably *P. brosimos* Merr. & Perry), called Weramo by the natives of these parts, was grown for its nutritious oily seeds. Large-seeded species of *Pandanus* are widely cultivated by the mountain peoples of New Guinea. They were seen at the head of the Fly River by the Archbold Expedition of 1936–37, and *P. Jiulianettii* Mart. and another species were planted very extensively in the mountains visited by the 1933–34 expedition.

On November 9 the collecting party moved down the slopes another 5½ hours, by the path that had been followed from Lake Habbema, to a camp established by Teerink at 2200 m. elevation on the right-hand bank of the Bele River, a tributary of the Balim. This was near the upper limit of permanent native habitation. Although narrow here, and very steep, the valley carried on its lower slopes an old established population of several hundred people who lived in hamlets of small round houses thatched with grass. Surrounding the hamlets and extending up the slopes to approximately 2400 m. were considerable areas of cleared land occupied by producing gardens, second growth forest and grass. Scattered gardens occurred in the tall *Nothofagus*-forest as high as 2480 m. The subsistence crop was sweet-potatoes, supplemented by sugarcane, very good bananas, cucumbers, a gourd, spinach and taro. Tobacco was also grown, and the people were rich in pigs. So great was the demand for the small cowrie shells carried by the expedition as

trade that, in the interests of the natives, who sold without regard for their own needs, the purchase of foodstuffs had to be curtailed.

During November, a new base was formed by the military party, and supplies laid down by the airplane, on the Balim River, three days' march below the meeting place of the Teerink and van Arcken patrols in the Grand Valley, and three days from the camp on the Bele. The Lake Habbema base was then abandoned. On December 5, Teerink having rejoined the scientific party with all the carriers, the Bele River Camp was in turn vacated.

For the first of the three days' march to the Balim, the route followed the east slopes of the Bele Valley. After skirting a deep limestone gorge by a climb to 2500 m. through virgin forest, in two hours the path dropped down to 2400 m. on the edge of the heavily populated slopes of the lower valley. From there on, intensively cultivated village groups of gardens, alternating with open grass and scrubby fallow lands, were traversed hour after hour. Population was equally heavy and gardens as numerous and extensive on the opposite slopes, and ahead was always the Grand Valley itself. Above the gardens on either side the forests continued in narrowing strips on the crests of the mountain ridges, beginning at first at about 2400 m., but following the ridges to 2200 m. as they dropped down to the edge of the Balim Valley. Below that only remnant clumps of primary forest, mostly of *Castanopsis* and oaks, dotted the slopes down to the rocky bed of the river. In most parts cultivation seemed to have been pushed up the slopes to the climatic limit at which, in this valley, crops could be grown. There was, however, on the upper slopes, still some activity in bringing new land under production. Where timber was available, logs piled one above another, or split stakes placed upright in the ground, were used for fencing the gardens and constructing contour works which, in conjunction with drains, were designed to control surface run-off and the resulting soil erosion. Often, however, stones were the only material available in quantity for such purposes. All these works — the destruction of the original heavy forest, the fencing, ditching, measures of soil conservation, and the carefully tilled fields — were the achievements of a people whose only implements were stone axes and adzes for cutting and sharpened sticks for digging.

At 7 o'clock on the second day, having camped at 2200 m. on the slopes of the Bele, high above the river, the party came out on the edge of the Grand Valley. A white cloud field, above which the high enclosing mountains rose clear and blue, filled most of the valley at that early hour. At 9 o'clock the clouds were entered as at 2000 m. the path swung

east away from the Bele. About this level were seen the last of the cultivated *Pandanus,* which hitherto had been conspicuous on old garden lands and in the neighbourhood of villages. At 1900 m. *Araucaria* trees, shaggy with lichens, began to loom up in the mist. Soon, on the ridges, there were many of these striking trees of the mid-mountain levels, growing in patches of primary oak and *Castanopsis* forest. In the hollows were secondary forests of a flat-topped *Albizzia.* For the rest of the day the way lay through attractive park-like country cut by streams and traversed by broad pebbly paths and narrow tracks through the grass, the ground often corrugated by old garden beds. Although scattered now, and inclined to be hostile, a heavy population once occupied this part of the valley.

The fertile and thickly populated plains of the Wamena tributary of the Balim were crossed early on the third day. Here the people were placid and cordial, and while some gathered to watch us pass, others continued digging in the rich black earth of the gardens. There were no fences. Surrounding and intersecting the sweet-potato fields were trenches, about 2 m. deep and nearly as wide, which served the double purpose of draining the land and keeping out the cherished, but always troublesome, village pigs. An hour was spent in getting the party across the Wamena — a rapid stony stream fringed with lines of tall casuarinas.

The Balim base camp was on the right-hand or south bank of the river at an altitude of 1600 m., four hours from the crossing of the Wamena. About 100 m. wide at that point, strong-flowing and deep, about a kilometre below camp the river began to fall away in rapids and break up around little islands upon approach to the gorge through which it joined the Reiger. In this narrowing lower end of the valley occurrences of sandstone were frequent, but the rock appeared to be chiefly limestone containing quantities of fossil coral. On the south side of the valley the slopes of the Snow Mts. arose to a jagged high crest of limestone cliffs, and were deforested and cultivated up to an altitude of about 2300 m. A huge erosion cut in soft yellow sandstone, and below it an extensive spoil fan extending to the river 1 km. above camp, made a conspicuous landmark. Across the river, on the north side of the valley, a limestone range, completely deforested but for a clump of araucarias, rose to an altitude of about 2400 m. A numerous population occupied both slopes and especially the bottom of the valley. The gardens of the slopes were walled with loose stones; those of the alluvial flats were drained by deep ditches and enclosed in wooden fences or walls of puddled earth.

On this part of the Balim, as in much of the Grand Valley, a species of *Casuarina* (*No. 11172*), wind-dispersed from its original habitat on the banks of streams and perhaps sometimes planted, played an important part in the domestic economy of the people as practically the sole source of fuel and wood for building. Although the species was very abundant and formed forest stands about the expedition base, *Casuarina* poles for camp construction and wood for cooking could be had only by purchase with the coveted cowrie shells. Care was taken in the preservation of the few relic trees of the original forests. For some species, protection seemed to be assured by tabu. Permission was denied to take wood specimens from their trunks, which was not surprising under the circumstances, and even the collection of herbarium material was viewed with horror by the natives who followed every activity of the expedition in the field.

Collecting at the last of this highly successful series of Snow Mountains camps was concluded with the evacuation of the last of the party to the Idenburg by air on December 20.

Only 50 m. above sea level, Bernhard Camp, the expedition base on the Idenburg, was situated on an old cut-off bend of the river about 1 km. from the foot of the mountains that rise from the southern edge of the Meervlakte. From there the way into the mountains was made easy by the explorations of van Arcken, who, with the view of facilitating the work of the scientific party, had penetrated a distance of 18 km. to the southwest and opened up a route by which an altitude of 2250 m. could be reached in 2½ days from the river. Beginning at 1800 m., camps were occupied at 2150 m., 1200 m. and 850 m. in the four months January to April. The field work of the expedition terminated at Bernhard Camp on May 10, 1939.

In the next eleven sections of this account the vegetation of the various camp localities is described in a geographical sequence, beginning with the coast and ending with the alpine heights.

Humboldt Bay

Only small collections of plants, comprising about 200 numbers in all, were made in this area. Attention was confined to the lower southeast slopes of the Cyclops Mts., the shores of the inner harbour known as Jautefa Bay, and the vicinity of Hollandia itself. A few species were also collected at Lake Sentani. The average annual rainfall at Hollandia is 2336 mm., of which 64 per cent falls in the six months November to April, and 36 per cent during the period May to October. February,

with an average of 310 mm. of rain, is the wettest month; September, with 86 mm., is the driest.

The terrain is ridgy to mountainous and both calcareous and non-calcareous rocks are present in the area. The primary vegetation cover, at the levels examined, consists of rain-forest, broken by occasional sago swamps. On the limestone ridges *Pometia pinnata* Forst. is one of the most abundant large trees in fairly luxuriant forests with a plentiful herbaceous undergrowth characterized by mesophytic ferns and especially tall-growing *Selaginella caudata* (Desv.) Spring. The other ridges carry a drier type of heavy forest in which rough-barked *Syzygium* spp., **Gordonia papuana* Kobuski, *Anisoptera 9000* and at least another dipterocarp are common trees, woody undergrowth plentiful, and the harsh fern *Syngramma pinnata* J. Sm. the characteristic floor plant. Oaks appear in the forest at an altitude of about 350 m. on the Cyclops Mts. Two hundred metres higher, mosses and liverworts are abundant on both trees and ground of tall moist forests containing many small tree-ferns (*Cyathea melanoclada* Domin and **C. pulcherrima* Copel.), and in which climbing *Nepenthes 8942* and *Cyathea biformis* (Ros.) Copel. are striking features of the undergrowth. Growing at still higher elevations, and conspicuous on the skyline, is an uncollected species of *Araucaria*.

Considerable areas of secondary grassland occur on the coastal fringe. This condition seems to obtain chiefly on the non-calcareous ridges, which have suffered more disturbance than the more fertile but generally more rugged limestone ridges. Also, the *Macaranga-Homalanthus* second growths that spring up after the destruction of primary forest on calcareous soils are more vigorous than the communities of *Commersonia Bartramia* (L.) Hieron., *Deplanchea 8975*, *Xanthostemon 8801*, etc., that appear on non-calcareous soils. About Hollandia township, where disturbance is comparatively recent, lalang grass (*Imperata*) has taken firm hold. On Jautefa Bay, and at Lake Sentani, are old-established grasslands dominated by *Themeda triandra* Forsk., one of the principal grasses of the dry *Eucalyptus* savannas of southern parts of New Guinea, with which occur many common southern associates, such as *Euphorbia serrulata* Reinw., *Knoxia corymbosa* Willd., *Sopubia trifida* Hamilt. and *Uraria* sp.

Seemingly long deforested slopes, touching on the bay to the northeast of Hollandia, support distinctive communities of grass and fern and also woody growths. There the red, non-calcareous, lateritic soil has a powdery texture, sets hard when exposed to the sun, and appears far

* denotes a new species, ** a new genus and new species described from this collection.

from fertile. A good part of the area carries a tangled growth of *Dicranopteris linearis* (Burm.) Underw., which is replaced on the more sterile soil by scattered tufts of *Eriachne pallescens* R. Br. and the clump sedges *No. 8802* and *Vincentia 8803*. Pure growths of *Ischaemum pubescens* Merr. cover extensive slopes. This grass would appear to follow the fern as a stage in succession and to set up conditions allowing the establishment of secondary forest. Associated in scattered order with stunted examples of second growth trees found elsewhere, and lending a distinctly Australian aspect to the fern and grass communities, are the small trees *Acacia Simsii* A. Cunn. and *Casuarina 8820*, and also shrubberies of *Myrtella 8887*. Dense pure scrubs of the *Acacia*, whose seeds germinate freely after a severe burning of the fern and grass, provide another characteristic feature of the area.

A peculiar xerophytic primary brush occupies some low coastal hills in Jautefa Bay. The hills are of raw coral limestone with a very rough surface in which are numerous pits and pockets of rich-looking though very dry red soil. In these accumulations of soil root such small trees and shrubs as *Mallotus 8844, Pittosporum ferrugineum* Ait. and *Myoporum papuanum* Kränzlin. The most conspicuous element of the brushes is the *Yucca*-like *Pleomele multiflora* Warb., which attains a height of 5–6 m. and raises its stout branches above the general level of its associates.

Bernhard Camp, Idenburg River

The cut-off bend on which this camp was situated received the waters of several creeks rising on the mountains nearby, and at its lower end was connected with the river. The outlet was a brisk hour's paddling or about 8 km. below the camp. For one-third of the distance, flood plain forests came out to the banks and ended in dense fringing growths at the water's edge. With the silting-in and narrowing of the channel from about 400 m. to 100 m. at that point, the forests began to give way to open stands of swamp-inhabiting trees and bodies of floating grass in quiet bays too deep for trees. Below the narrows the channel meandered through extensive grass marshes, dotted with low trees and containing forested islands, and then cut through a silt levee covered with a tall stand of purple-plumed wild sugarcane to join the river. The old river-bed above the upper end of the "lagoon" was almost filled with silt and so choked with marsh vegetation and encroaching swamp-forest that a canoe could not be got through to the river.

The lagoon rose and fell with the fluctuations of the Idenburg. A datum pole for observations on water level was erected by van Arcken

on July 11 and series of levels recorded up to October 18, after which regular daily records were kept until May 8. The water was at its lowest in August. September was a wet month locally, and early in October a brief flood of 8 m. occurred. November marked the beginning of the rainy season at Bernhard Camp; from November 3 to the end of the year, minimum water level was 4.5 m. and maximum 7.3 m. on the datum pole. The lowest level between January 1 and May 8 was 5.9 m., and for periods of 11 consecutive days in January, 12 in February, 22 in March and 16 in late April and early May, the level exceeded 8 m. The highest flood, in March, rose to 9 m. Absolute low level, estimated at minus 1 m., was not formally recorded. Since in this case the duration of inundation and of dry surface conditions is more important ecologically than extreme levels, the difference between absolute high and low water, whether 9 or 10 m., is not of great moment.

Rainfall records kept by the military party indicated a total precipitation of 4934 mm. between July 11 and May 8. The driest full month was August, with 259 mm., the wettest April, with 802 mm. of rain. The wettest months at Bernhard Camp coincided with the highest and most sustained floods, and the driest month with the lowest water; this denoted for the upper drainage basin of the Idenburg a seasonal rhythm which, for Bernhard Camp, could be assumed from the character of the vegetation of the lower mountain slopes, namely, a wet season corresponding with the incidence of the northwest monsoons, and a relatively dry season during the period of the southeast tradewinds.

The observations of the writer were limited to the wet season. When, from April 6 to May 10, collections were made here, the marshes were too deep in water to be sounded with a pole, and most of the flood plain forests could be traversed by canoe. At one time all but the highest ground in camp was under water, and only two other dry spots could be found out from the narrow strip of rising land that fronted the mountains. A comparison of soundings with the flood tables of van Arcken gave some idea of the depth and duration of inundation as affecting the various types of flood plain vegetation.

The plant communities of the flood plain, some of which were observed under dry season conditions on the Fly River in 1936, fell into two groups, viz. permanent marshes and semi-permanent swamp-forests, and communities inundated only in the flood season.

In the first category, in order of depth of inundation, were:

1) **Permanent grass-marsh:** Present in sluggish creeks and covering extensive areas of old riverbed as dominant of the open marshes was the

grass *Echinochloa stagnina* (Retz.) Stapf, whose long buoyant culms root on the bottom. With it were associated *Commelina 13992*, *Polygonum 14068* and *Jussiaea repens* L., of similar habit. *Pistia stratiotes* L. was present as a floating aquatic. Similar marshes occurred on the Fly River.

2) **Adina swamp-forest:** The clear-boled slender *Adina 13909*, averaging 25 m. in height, formed pure open forests of limited extent on ground covered to an average depth of about 4 m. by the highest flood and continuously under water for 38 days in November–December and for the 128 day period January 1 to May 8. The smooth grey trunks of the trees carried quantities of fleshy sun-epiphytes such as *Dischidia 14048*, *Hydnophytum* spp., *Hoya* spp. and *Cyclophorus lanceolatus* (L.) Alston. Forests of this kind covered large areas on the Fly River.

3) **Barringtonia swamp-forest:** The bushy, briefly deciduous *Barringtonia spicata* Bl. formed extensive pure stands 5–6 m. high. The highest flood inundated this forest to an average depth of about 3 m., so that in general the habitat was flooded continuously for 13 days in November, and for all but two days between January 1 and May 8. The closely related *B. tetraptera* Lauterb. forms swamp-forests in south New Guinea.

4) **Sago-swamp:** Although very extensive on other parts of the Meervlakte, forests of sago palms (*Metroxylon*) occupied but a few small areas within tall rain-forest at Bernhard Camp. The river flooded this habitat to a maximum depth of about 1 m. In the southeast season, local rains no doubt suffice to maintain the more or less swampy conditions essential for this palm. Sago-swamps occur in rain-forest throughout the lowlands and lower mountains of the island.

5) **Swampy rain-forest:** On the edge of the flood plain were patches of a rather open type of mixed rain-forest inundated by the river to depths of under 1 m. to about 1.5 m. (flooded about 50 to 98 days between January 1 and May 8). From the uneven ground surface and the presence as characteristic herbaceous undergrowth of *Hypolytrum 13974*, the amphibious fern *Microsorium pteropus* (Bl.) Copel., and *Oryza Ridleyi* Hook. f., more or less swampy conditions would appear to be maintained after the fall of the river waters. The principal trees *Campnosperma? 13963*, *Couthovia 14097*, *Parkia 13824* and *Serianthes 13970* attained a height of 30–35 m. and developed in some cases heavy prominently buttressed trunks. *Styrax 13953* and *Ardisia 13897* were characteristic of a rather open woody undergrowth, while *Pandanus peni-*

cillus Mart. and the fan-palm *Borassus 13775* figured conspicuously in the substage.

The second category included:

6) **Cane brakes:** *Saccharum spontaneum* L. (?) formed extensive brakes 8–10 m. high on the silt levees of the river, and also grew on gravel beds in creeks draining from the mountains. As peak floods inundated the levees to depths of 2.5–3.5 m., on the average they would be under water on all but two days between January 1 and May 8. Whatever plants occurred on lower banks of silt and mud were under water and out of sight during the period of observation; but species growing on old drift logs afloat in backwaters, such as *Torulinium ferax* L. C. Rich., *Fimbristylis miliacea* (L.) Vahl., *Pouzolzia zeylanica* (L.) Benn., *Jussiaea 13928* and *Abelmoschus 13777,* probably belonged to such a community.

7) **Timonius-forest:** Pure forests of *Timonius 14034,* about 25 m. high, occupied, at the lower end of the lagoon, extensive siltbeds submerged to a depth of 1.5–2 m. by the highest flood (flooded on an average 73 days, and dry 45 days between January 1 and May 8). Breadfruit trees (*Artocarpus communis* Forst.), no doubt brought there in the first place by the scattered nomadic natives of the river, were frequent marginal associates. *Pothos 13943,* climbing on the trees, was a characteristic feature. The *Timonius*-forests appeared to represent the one successional stage between cane-brakes and mixed rain-forest on the silt levees of the river.

8) **Nauclea-forest:** Pure stands of the 6–7 m. high small tree *Nauclea 14033,* remarkably like a low *Sonneratia alba* mangrove community in appearance, covered flat islands in the lagoon and sometimes fringed its banks. They grew on ground submerged to a depth of about 2.7 to 3.7 m. by the highest flood. Complete flooding was therefore the average condition from January 1 to May 8.

9) **Wormia-forest:** Plains generally inundated to a depth of 2.25 to 2.5 m. at highest flood level, and therefore under water 117 to 120 days in the period January 1 to May 8, carried distinctive mixed rain-forests in which *Wormia 14114* took a prominent part and formed nearly pure stands of considerable extent. Readily distinguished by its reddish flaky bark and large leaves, the characteristic tree attained a height of about 30 m. and a diameter of 1 m. The trees were well spaced and, there being little woody undergrowth, the forests were open underneath. Any herbaceous undergrowth they may have contained was under water

in the flood season. Strangling figs, whose great crowns rose high above the forest roof, were a conspicuous feature. *Stenochlaena palustris* (Burm.) Bedd. and *Pothos 13943* were prominent root-climbers. But the feature that impressed most, as one travelled through the forest by canoe, was the wealth of large shade epiphytes, such as *Asplenium ellipticum* (Fée) Copel., **A. pseudophyllitidis* Copel., **Goniophlebium subcordatum* Copel., *Microsorium punctatum* (L.) Copel., *Humata heterophylla* (Sm.) Desv., *Selaginella Hieronymiana* v. A. v. R. and Zingiberaceae, that crowded the tree trunks down to about 2 m. from high water mark and provided a wet season refuge for innumerable ants and other insects. *Wormia* entered the swampy rain-forest, described above, and possibly these forests also remained somewhat swampy after the floods.

10. **Fringe communities:** The *Nauclea, Adina,* and sometimes the *Barringtonia* forests present open faces to the waterways, and the trees straggle out into the open marshes. These trees also occur with an entirely different set of species in a dense fringing vegetation that hides from sight the interior of other types of flood plain forest. It is in these fringe communities, their aërial parts rising from anything up to 3 m. of water in the wet season, that the richest assortment of woody plants is found on the river plains. *Gnetum latifolium* Bl. and the magnificent red-flowering *Mucuna 13789* are abundant as screening lianes on the face of the forest. Bordering the *Wormia* type of forest, and leaning low over the water, is a continuous line of *Syzygium 13930,* up to 20 m. high. Elsewhere, much of the fringe vegetation is made up of *Kleinhovia hospita* L., *Pongamia pinnata* (L.) Merr., *Hibiscus tiliaceus* L. and *Crataeva 13910* as trees, and such scrambling shrubs as *Combretum 13786, Faradaya 13918, Loeseneriella sogerensis* (E. G. Baker) A. C. Smith, *Caesalpinia nuga* Ait. and *Flagellaria indica* L. On the lowest banks *Ficus 14036,* with large scabrous leaves, forms level thickets that stand not more than 1–1.5 m. above water at high flood and support an abundance of *Cayratia 13947,* pink *Ipomoea 13940,* spinose *Acacia 13776,* and other climbing plants.

From a few metres to about 0.5 km. in width, the strip of rising ground between the flood plains and the lift of the mountains consists of low stony ridges and gently sloping flats for the most part somewhat swampy in the wet season. Here there are pronounced changes in the character of the forest. On the flats and lower ridges, flood plain trees such as *Couthovia* and *Parkia* occur in abundance, while many species found as high as 600 m. and 800 m. on the mountains come down to the edge of the flooded ground. *Intsia 13542,* up to 40 m. high and well over 3 m.

in girth, *Terminalia 13925, Elaeocarpus 13569, Sloanea 14029* and *Duabanga moluccana* Bl. figure as canopy trees, and *Gnetum gnemon* L., *Harpullia cauliflora* K. Sch. & Lauterb., and *Garcinia 14065* as substage trees. Palms are numerous on the flats, where *Calamus* spp. and a *Korthalsia* make their first appearance, *Borassus 13775, Rhopaloblaste 13809* and *Cyrtostachys 13807* abound in the substage, and *Licuala 13744* and *Linospadix? 13774* mix in a rather plentiful woody undergrowth. The palms, a plentiful herbaceous layer of *Elatostema 13816* and *Ophiorrhiza 13812,* the local abundance of the small climbers *Freycinetia Klossii* Ridl. and *Piper 13904,* mosses on the undergrowth, and an abundance of *Pellionia 13771* and ferns such as *Asplenium acrobryum* Christ, *Polypodium damuense* Ros., *Hymenolepis mucronata* Fée, *Campium heteroclitum* (Presl) Copel. and *Vandenboschia aphlebioides* (Christ) Copel., as mesophytic low epiphytes, give an appearance of lowland luxuriance to a forest which is, however, actually poor in species.

850 M. CAMP, 4 KM. SOUTHWEST OF BERNHARD CAMP

A steep climb of three hours from the edge of the flood plain brought one to the top of the first mountain ridge at 900 m. altitude. Up to about 700 m. the slopes carried a poor type of tall dry-appearing rainforest with a thin canopy, in which *Intsia 13542, Pometia pinnata* Forst., *Shorea 14001, Serianthes 13546, Cynometra 13572, Alstonia 14013, Syzygium 14030, *Parastemon Versteeghii* Merr. & Perry, *Myristica fusca* Mgf. and *Garcinia 13570* were frequent trees below 300 m., and Cunoniaceae *13505, Endiandra 13198, Pygeum 13187, Turpinia 13532* and *Dysoxylum molle* Miq. prominent above 600 m. Oaks (*Lithocarpus 13556*) appeared at 120 m. and became plentiful above 350 m., but were nowhere abundant enough to characterize or bring about changes in the forest. The lower tree layers were poorly developed, epiphytes few, and lianes almost absent. A sparse predominantly woody undergrowth contained *Astronia 13671, Clerodendron 13474, Antidesma 13832* and *Amaracarpus 13863* as slender trees of 4–6 m., *Ixora 13448, Lasianthus 13670* and *Ardisia 13676* as shrubs, the fan-palm *Licuala 13744,* and slender *Pandanus Krauelianus* K. Sch. Only on flat places on the spurs, where the coarse ferns *Craspedodictyum Schlechteri* (Brause) Copel., *Tectaria cesatiana* (C. Chr.) Copel. and *Taenitis blechnoides* (Willd.) Sw., *Lindsaya azurea* Christ, *Selaginella suffruticosa* v. A. v. R., etc., congregated in quantity, was there any massing of undergrowth plants.

At 750 m., the level above which clouds settled over this slope of the ridge as a regular thing after the middle of the forenoon, matted surface

roots covered parts of the spurs and the ground became slightly mossy. Some well grown specimens of *Agathis 13171* attracted attention as an indication of a changing flora. Undergrowth remained sparse as ever, but numerous epiphytes appeared in the tree trops. An unexpected find was the tree composite *Olearia 13179,* a member of a genus most common in the subalpine zone, and not met with above 850 m. on these slopes or below 2600 m. on the Snow Mountains.

In an abrupt change, within 50 m. of the summit, the very mixed tall rain-forest gave place to a forest altogether different in character and composition and rapidly diminishing in height. While lower on the slopes the mist hung in the tree-tops, here it drifted through the forest to be absorbed by the thick coating of green and brownish bryophytes that covered the root-matted ground and enveloped the trunks of the trees. In places the carriers had worn the path down through 20–50 cm. of moss and peat to the underlying yellow clay. On the crest, where the largest trees were about 20 m. high and 0.5 m. in diameter, stilt-roots tented with moss were a conspicuous feature. The trees developed dense richly branched crowns and had smallish, recurved, often emarginate glossy leaves. Even when the sun shone, the forest was dimly lighted.

Although relatively poor in species, the "mossy-forest" of this 900 m. ridge exhibited most of the characters of the formation at higher altitudes on this mountain complex and on the Snow Mts., and was essentially a forest of antarctic beech. Associated with the dominant *Nothofagus 13147* were the conifers *Podocarpus imbricatus* Bl., *P. 13519* and especially *Phyllocladus 13520, Metrosideros 13149,* and a few minor species such as *Rhodamnia 13524* and *Endriandra 13678.* Scattered *Agathis* and the palm *Gulubia 13099* protruded above the canopy. Subsidiary trees, chiefly *Astronia 13312* and *Tetractomia Lauterbachiana* Merr. & Perry, extended their tops into the branches of the canopy trees and did much to exclude light from the forest. Often absent except for a few small ferns and *Argostemma 13316,* an abundant woody and herbaceous undergrowth of chiefly **Pandanus leptocaulis* Merr. & Perry, 1.5–2 m. high, *Dianella 13317* and *Mapania 13097,* developed under the somewhat broken canopy on crests and steep slopes, where subscandent *Oleandra cuspidata* Baker, *Cyathea biformis* (Ros.) Copel. and small *Freycinetia* spp. massed themselves on both ground and tree-trunks. Climbing *Nepenthes 13669* with big green pitchers, **Freycinetia pleurantha* Merr. & Perry, and especially the bamboo *Schizostachyum 13327* ascended to the upper levels. Poor for this type of forest, the epiphytic flora consisted mainly of Hymenophyllaceae and small orchids.

The 850 m. Camp lay beyond this ridge in a mountain-locked valley

dominated on the other side by a 1600 m. crest on the range on which the higher camps of this series were situated. Swampy in parts, and drained by a considerable stream named Araucaria Creek for stands of *Araucaria 13108* that occurred on its lower course, the valley bottom broadened to approximately 0.5 km. above the camp. Below camp the mountains gradually closed in and the creek became a succession of rapids, pools, and small waterfalls. The character of the forests indicated for this valley a rainfall far greater than that of Bernhard Camp and the intervening slopes. Dull, showery weather, broken by only six fine days, prevailed during the occupation of the camp from March 6 to April 15. Early morning fogs were frequent, and daily mist clouds, nearly always descending to the same level on the slopes, capped both the 900 m. and 1600 m. ridges at about 9 a.m. Often the day would end with torrential rain and strong wind from thunderstorms between 4 and 7 o'clock, followed by a steady downpour lasting far into the night. Temperature[1]: maximum (27 days) 22.5–28, mean 25, minimum (27 days) 16.5–19, mean 18 degrees Centigrade.

Rain-forests filled the valley bottom and extended up the slopes to *Nothofagus*-forest on both sides. But on the south slope, between 870 m. and 950 m. altitude, some broad ridges, at best poorly drained and in parts swampy, carried a distinctive type of forest dominated by *Agathis 13171*. The trees rooted shallowly in a compacted grey sand covered with a thin layer of peaty plant remains and living moss. A stately tree, up to 45 m. high and 1.5 m. in diameter, the older specimens standing in a mound of rotting bark scales, the *Agathis* formed a very open stand above a thin subsidiary layer of slender *Metrosideros 13291, Quintinia 13703, Campnosperma 13338* (peculiar to this forest) and *Daphniphyllum 13705,* 15–20 m. high. **Ternstroemia Merrilliana* Kobuski was a characteristic small tree in the more open parts, where *Astronia 13292, Drimys 13704* and *Pandanus stenocarpus* Solms-Laub. (?) supplied a rather abundant woody undergrowth. The ferns *Taenitis blechnoides* (Willd.) Sw., *Dryopteris viscosa* (J. Sm.) O. Ktz. and *Macroglena meifolia* (Bory) Copel. typified the ground flora, and *Hanguana 13304,* found nowhere else, occurred throughout. Other characteristic elements were root-climbing *Freycinetia* spp., *Cyathea biformis* (Ros.) Copel. and *Aeschynanthus 13300,* massed about the lower tree-trunks, and *Leucostegia pallida* (Mett.) Copel., **Humata Archboldii* Copel. and red-flowered *Dichrotrichum 13302* as low epiphytes. High epiphytes, mostly associated with cushioned bryophytes, included *Hydnophytum* spp. and

[1]Unless otherwise stated, meteorological readings were made 1 m. above the ground under a thatched roof in the various camp clearings.

the curious "ant-house" fern *Lecanopteris pumila* Bl. Like the *Nothofagus*-forest, from which many of its principal components were derived, the *Agathis*-forest, except for *Agathis* itself, was well mossed above as well as on the ground. It should probably be regarded as an edaphic subclimax of the rain-forest, which surrounded it on all sides, and in which, in this climatically wet valley, *Agathis* occurred in quantity.

Mossy to a degree seldom seen, and often retarded in their development by unfavourable soil conditions, the rain-forests presented other unusual features. One of these was the abundance of oaks (*Lithocarpus 13522, L. 13143, L. 13120*) and *Castanopsis 13521* on both the ridges and flat lands. Another oak (*L. 13466*) actually dominated the forest in swampy parts of the valley bottom, where the ground was broken by muddy pools, and scrambling bamboo combined with *Calamus* spp. and young *Pandanus* to form a prickly undergrowth difficult to penetrate. *Casuarina sumatrana? (13130)*, which, like *Agathis*, ranged up the slopes to 1200 m. and was not met with in any other locality, was conspicuous on steep ridges and sandy creekbanks.

The rain-forests attained their best expression on the deep sandy loam of river flats raised above the level of normal floods, where *Schizomeria 13117, No. 13309, Sloanea 13129, *Dysoxylum Randianum* Merr. & Perry, *Santiria 13111, Calophyllum 13122, Syzygium 13125, Hibiscus 13126, Cryptocarya 13127, Evodia Forbesii* Baker f., the oaks and *Castanopsis*, and some less important species formed the canopy layer of a well developed forest fully 30 m. in height. Most of the trees were conspicuously mossy. Mosses also covered exposed surface roots and rotting debris, while a thin layer of leaf litter lay on the ground. Young trees of the canopy species provided ill-defined second storey and substage layers enriched by the tall palms *Actinorhytis? 12966* and *Orania 13375*. High-climbing lianes, including *Calamus 13341* and several Apocynaceae, were well represented. There was a rich undergrowth, containing *Psychotria 13637, *Kibara elongata* A. C. Smith and *Codiaeum 13695* as small trees, *Licuala 13436* and *Linospadix? 13233* as palms, and an abundance of the tree-ferns *Cyathea geluensis* Ros. and exceedingly slender **C. gracillima* Copel., but chiefly characterized by herbaceous plants and ferns, such as *Procris* spp., *Elatostema* spp., *Tectaria cesatiana* (C. Chr.) Copel., *Dryopteris micans* Brause, **D. multiauriculata* Copel., *Selaginella velutina* Cesati, and at least a half-dozen species of *Begonia*. Epiphytes, both herbaceous and woody, were exceptionally abundant in association with climbing *Freycinetia angustissima* Ridl. and *Schizostachyum 13327* on the tree-trunks and on the undergrowth. Most important of these were the ferns *Arthropteris*

dolichopoda v. A. v. R., *Meringium gorgoneum* Copel., *Polypodium accedens* Bl., *P. albidosquamatum* Bl., *Goniophlebium subauriculatum* (Bl.) Presl, *Leucostegia pallida* (Mett.) Copel., *Nephrolepis Lauterbachii* Christ, **Asplenium paedigens* Copel., *A. cromwellianum* Ros., *Hymenolepis revoluta* Bl., *Lindsaya marginata* Brause and *Loxogramme subselliguea* (Baker) Alston, *Elatostematoides 13688, Ophiorrhiza 13059* and *Medinilla 13226*. In the tree-tops, which also carried a varied complement of epiphytes, *Polypodium enerve* Cav. and **Humata deltoides* Copel. grew half buried in moss, *Nepenthes 13232* with narrow green pitchers was common, and *Rhododendron* made its first appearance in the form of *R. 13067*, a shrub with showy reddish flowers, also found on open banks of the creek.

Throughout the lower mountains of New Guinea, there occurs on the edges of streams a community of flood-resistant small trees, alike in the horizontal arrangement of their branches, and, as a rule, with narrow lanceolate leaves. The branches of these trees may form one or more layers with a spread equal to or exceeding their height, which averages 2–3 m. As represented at Araucaria Creek, the community consists of *Ficus 13222, F. 13228, Syzygium 13223,* the clump palm *Actinophloeus 13700* and massed growths of *Boerlagiodendron 13697,* the latter an attractive shrub with narrow-palmate leaves and purplish inflorescence. Equally widespread and characteristic is an associated herbaceous community, restricted to firm banks and flood-washed points of rock, of which *Dryopteris cesatiana* C. Chr., *Lindsaya crassipes* Ros., *Dryopteris mutabilis* Brause, **D. riparia* Copel., *Selaginella Kerstingii* Hieron., *Hemigraphis 13100,* and the grasses *Pogonatherum paniceum* (Lam.) Hack. and *Isachne micrantha* Merr. are the most important local species. *Impatiens 13066* produces striking displays of salmon-pink flowers on the gravel beds.

Good examples of rain-forest succession occurred on the flood banks of the creek. As pioneer on beaches of gravel and sand, *Saccharum spontaneum* L. formed brakes up to 8 m. high, in which climbing *Cissus* spp. and *Mikania cordata* (Burm. f.) B. L. Rob., the shrubs *Otanthera 13063* and *Clerodendron 13062,* and small trees *Pseudopipturus 13078, *Parasponia simulans* Merr. & Perry and *Breynia 13077* appeared as the first woody plants. The quick-growing small softwood trees *Saurauia 13265, S. 13394, Wendlandia 13284, Schuurmansia 12766, Dammaropsis Kingiana* Warb. with leaves 75 cm. long and 50 cm. broad, and the magnificent tree-fern *Cyathea contaminans* (Wall.) Copel. played a prominent part in succeeding stages, which culminated in a 25 m. stand of *Homalanthus 13268* and *Albizzia 13141*. Ground societies of *Nephro-*

lepis hirsutula (Forst.) Presl, *Dryopteris unita* (L.) O. Ktz., *Elatostema* spp. and the orchid *Spathoglottis 13080* were well developed in open parts of the young forest. *Macaranga,* one of the principal genera of rain-forest "second growth" trees, was represented by only one species, and that of minor importance.

1200 m. Camp, 6 km. southwest of Bernhard Camp

From this camp one looked up to the 1600 m. crest which has already received mention, and down into the valley of Araucaria Creek. The country sloped sharply in well defined spur ridges separated by ravines with sides so steep as to be somewhat unstable. Although 350 m. higher in the mountains, rainfall was probably not so great, and certainly there was less mist and fog than in the valley of Araucaria Creek. Temperatures, recorded for 12 days between February 11 and March 3: maximum 20.5–23, mean 22, minimum 15–16.5, mean 16 degrees Centigrade.

Here the oaks (*Lithocarpus 12521, L. 12569, L. 12589, L. 12598, L. 13102*) and *Castanopsis* appeared in their true character as the constituents of practically pure forests on the broader ridge crests. About 25 m. high, with slightly spurred greyish trunks sometimes surrounded by coppice shoots, the oaks grew well apart and formed a rather thin canopy. In spite of abundant illumination, subsidiary and substage trees were few. Slower to decay than those of most rain-forest species, the leaves of the canopy trees formed a rustling ground litter. The distinctly dry appearance of the forest was accentuated by the scarcely mesophytic aspect of the fern *Syngramma Hookeri* C. Chr., which characterized the sparse undergrowth, the fleshy small twiners *Dischidia 12863* and *Hoya 12845,* which found support on undergrowth and coppice shoots, and the common low epiphytes *Vittaria ensiformis* Sw., *V. elongata* Sw., *Oleandra Werneri* Ros. and *O. cuspidata* Baker. There were few high epiphytes, and usually only one canopy climber — *Dimorphanthera 12856.*

Oak-forest was, however, a rare development. The constituents ranged up and down the spurs in the prevailing rain-forest, showing preference for the crests, which, it might be mentioned, often were under mist when the ravines were clear of cloud. It was on the crests that *Agathis* reached the upper limit of its range at 1200 m.; *Phyllocladus 12523* and *Podocarpus imbricatus* Bl. descended to 1100 m. from the beech-forests and were common in places where beds of moss and surface roots covered the ground, and *Nothofagus 11963* assumed prominence at about 1400 m.

Exceptionally rich in tree species, woody and herbaceous under-

growth, lianes and epiphytes, the rain-forests of this mountain slope were the finest encountered on the expedition. On ridge tops and stable slopes, trees 35 m. high and often 1 m. in diameter formed a forest open in character under the canopy. There was considerable moss on the lower tree-trunks and on the abundant undergrowth of the ravines, and masses of bryophytes, mostly brown in colour, were conspicuous in the tree-tops. Where the rubbly soil of immature slopes afforded insecure roothold for large trees, the effects of damage by soil movement were seen in the irregular canopy and frequent openings filled with impenetrable tangles of *Calamus 13015* and *Schizostachyum 12825*.

In the rain-forests were many species common at 850 m. and even down to the plains of the Idenburg, but appearing not to extend much above this altitude. Mingled with these, and species of restricted altitudinal range, were others, especially ferns, which made their first appearance here but reached the peak of their abundance 500 m. higher on the mountains. Most of the bryophytes, ferns, and orchids of the tree-tops occurred in the mossy beech-forests of higher altitudes. Palms and Pandanaceae were less in evidence and showed a slight decrease in species as compared with Araucaria Creek, and few representatives of these groups occurred in both localities. Nine species of palms, including three of *Calamus*, a very common fan-palm (*No. 12852*) with large fruit of a bright orange colour, but only one tall species (*Actinorhytis? 12966*), were found between 1100 m. and 1500 m., as compared with ten from all types of forest at the lower camp. *Pandanus* was represented by five species and *Freycinetia* by four, as compared with five of each at the 850 m. Camp. The only large *Pandanus* was *P. penicillus* Mart., and only *P. limbatus* Merr. & Perry, gregarious in open places, occurred in any abundance. In *F. percostata* Merr. & Perry and *F. Archboldiana* Merr. & Perry, *Freycinetia* provided two of the most conspicuous large climbers of the forest.

An interesting feature of these forests, a feature which was to become more pronounced at higher altitudes, was the prominence of *Syzygium* (9 species collected) and Lauraceae (5 species) as trees of the canopy layer. *Syzygium 13018, S. 12543, S. 12548, Cryptocarya 12549, Endiandra 12530* and *Litsea 12520*, with *Schizomeria 12763, Podocarpus 12787, Calophyllum 12518, *Myristica Brassii* A. C. Smith, *M. Buchneriana* Warb., *Albizzia 12575, *Ilex Versteeghii* Merr. & Perry, *Elaeocarpus 13107, Terminalia 13009, Hibiscus 12978, Gordonia papuana* var. *montana* Kobuski, **Adinandra Brassii* Kobuski, *Platea 12554, Santiria 12546* and *Halfordia papuana* Lauterb. supplied much of the tree stocking; minor species included *Grevillea 12588, Ceratopetalum 12516* and

Galbulimima 12572, of interest for their Australian affinities. A subcanopy layer, best developed on unstable slopes and mainly of subclimax species, contained in addition to lowland elements such as *Erythroxylum ecarinatum* Burck. and *Sterculia 12765*, *Aristotelia 13016* and *A. 13024* also found in oak-forest, and *Xanthomyrtus 12971* as an accession from the beech-forest.

High-climbing lianes included, besides *Freycinetia* and *Schizostachyum*, *Mussaenda 12877*, red-flowering *Mucuna 12945*, *Morinda 13012*, *Ficus 13019* and *Dimorphanthera 12763A*, the last a white-flowering species of a mountain genus which made its first appearance on the open banks of Araucaria Creek. A very mixed woody undergrowth, 1–5 m. high, contained *Ixora 12860*, *Garcinia 12778*, *Anomopanax 12780*, *Ardisia 12812*, numerous tree-ferns (*Cyathea melanoclada* Domin, **C. pulcherrima* Copel., **C. gracillima* Copel.), and in the ravines *Cyrtandra 12776*, *C. 12920*, *Lycianthes 12907*, *Medinilla 12944* and *Poikilogyne 12981*. *Musa 12962* was conspicuous in ravines, where luxuriant herbaceous growths were characterized by *Dryopteris novoguineensis* Brause, **D. multiauriculata* Copel., *D. micans* Brause, *Leptopteris alpina* (Baker) C. Chr. var. *major* Ros. and *Tectaria decurrens* (Presl) Copel. as large ferns, *Elatostema 12946*, *Begonia* spp., *Pellionia 12936*, *Alocasia 12851*, *Homalomena 12972*, *Pentaphragma 12904* and Zingiberaceae and contained *Balanophora 12991*, commonly parasitic on the roots of several flowering plants. Numerous orchids associated with such ferns as *Asplenium scandens* J. Sm., *A. cromwellianum* Ros., *A. nidus* L., *Polypodium accedens* Bl., *P. diaphanum* Brause, *Nephrolepis Schlechteri* Brause, *Grammitis subrepanda* (Brause) Copel. and *Humata kinabaluensis* Copel. as low epiphytes, and *Aglaomorpha novoguineensis* (Brause) C. Chr. and climbing Araceae were abundant as higher epiphytes. The flora of the tree-tops included such diverse elements as *Sericolea 12862*, *Fagraea 12980* and *Ficus 12906* as trees of 10–15 m., the shrubs *Exocarpus Pullei* Pilg. and *Pittosporum Ledermannii* E. Pritzel, and on mossy branches the ferns *Oleandropsis ferrea* (Brause) Copel., *Holcocorus bisulcatus* (Hook.) Copel., *Ctenopteris eximia* Copel., *Humata Werneri* Copel., *Macroglaena Schlechteri* (Brause) Copel., *Davallia trichomanoides* Bl. and *Meringium rubellum* (Ros.) Copel., showy *Dendrobium* spp. and other small orchids.

(*to be concluded*)